COAL AGE

Established 1911—McGraw-Hill Publishing Company, Inc.

DEVOTED TO THE OPERATING, TECHNICAL AND BUSINESS PROBLEMS OF THE COAL-MINING INDUSTRY

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December, 1939

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Management and Machines

How MANAGEMENT employing modern technique and equipment can bring back an industry threatened with oblivion is again demonstrated in northern West Virginia. Only a few years ago, some observers were blandly suggesting that the Fairmont field was an overgrown war baby that could not hope to survive the more strenuous times of peace. Today these same observers sing a different tune. The mechanized mines of that district are pointing the way back.

AVERAGE PRODUCTION COSTS in northern West Virginia are now the lowest in the Appalachian region. Average tonnage per man-day in the principal counties in that field also tops all other Appalachian areas. Between 1935 and 1937, average output per man-day rose from 6.19 to 6.65 tons in Harrison and from 5.74 to 6.87 tons in Monongalia County. Logan was the only other county in the Eastern tier above a 6.0-ton level.

THESE LEVELS are composites of results at the steadily diminishing number of hand-loading mines, at partly and at completely mechanized operations. If only the last-named group is considered, the level is still higher. Estimates made by *Coal Age* during its survey of the field showed 12.5 tons per man-day in July, 1939, for fully mechanized mines in the five counties—Barbour, Harrison, Marion, Monongalia and Taylor—covered in this issue.

SUCH HEALTHY gains in so short an interval are a tribute to both speed and determination. Once progressive management decided that modernization offered the one hope of salvation in a competitive world little time was wasted in attacking the job. Northern West Virginia operators have been quick to see the advantages of concentration and how multiple shifting promotes such a system. The results are reflected in the high tonnage per man-day and in the lower costs they bring.

IN THE EARLY DAYS of mechanical loading, many questioned whether the machine could be used successfully in pillar robbing. Northern West Virginia has resolved all doubts on that score. Some of the best records made in this work are to be found in the Fairmont field. Perfection of technique and practice in machine mining of pillars is one of the outstanding contributions this district has made to industrial progress and to the cause of true conservation.

MECHANIZED OPERATIONS of northern West Virginia also have demonstrated the practical advantages of retreat mining. These advantages have played a part in concentration and in the high percentage of extraction. In the field of power, they have achieved enviable results in the tonnage output per kilowatt of installed capacity. These and other contributions to better mining at lower costs are set out in detail in the pages which follow.

FAIRMONT COAL FIELD

+ Includes Four Geological Series

In Highly Dissected Plateau

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THE Fairmont coal field of West Virginia is located in the north-central part of the State and includes portions of Monongalia, Marion, Harrison, Taylor and Barbour counties. The area in which this coal field lies is a highly dissected plateau ranging in elevation from 1,000 to 1,800 ft. above sea level. Streams in the area generally flow in narrow, deeply indented V-shaped valleys, with comparatively sharp and narrow divides between them. The Monongahela River and its chief tributaries, the Tygart and West Fork rivers, which drain this area, have cut deep gorges in this plateau from $\frac{1}{4}$ to $\frac{3}{4}$ mile in width.

The structure of this area is generally that of a monocline dipping to the northwest from the major Chestnut Ridge Anticline on the east. This regional dip, however, is interrupted by several minor folds such as the Indiana, Mooresville and Wolf Summit anticlines. Folding west of the Chestnut Ridge Anticline is not severe, so that the strata are comparatively horizontal and the fixed carbon of the coals, figured on a pure-coal basis, averages between 60 and 65 per cent, classing the coals of this area as high-volatile bituminous.

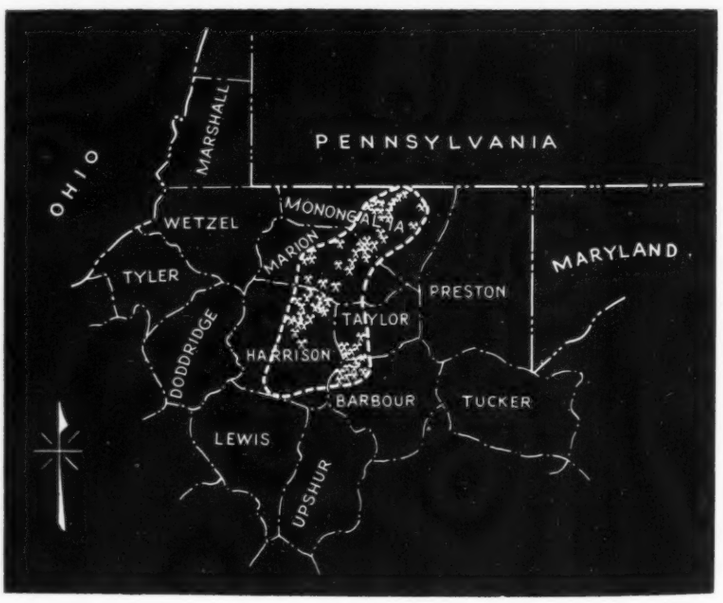
Surface rocks in the western part of this area are of Dunkard (Permo-Carboniferous) age, with progressively older beds outcropping to the east until the Pottsville is reached along the eastern edge of the area.

Dunkard Series—Formerly called the Upper Barren Measures, the Dunkard Series outcrops in the western portion of the field. This series is considered as being of "Permo-Carboniferous" age because of its similarity to the underlying Pennsylvanian rocks, even though it does contain some fossils which are definitely of Permian age. The series is composed of a succession of brown and grayish green sandstones, red shales, thin limestones and coal. Of the thirteen recognized coal horizons in the series, only one, the *Washington coal*, named from its fine development near Washington, Pa., attains minable thickness and purity in this area, where it occurs about 560 ft. above the Pittsburgh coal.

The Washington coal usually is a multiple-bedded seam, varying from 3 to 6 ft. in thickness, with the best coal in the lower part, as shown in the following section taken on Statler Run, Clay District, Monongalia County:

			Ft.	In.
Slate roof				
Coal, upper bench	1′ 2″	Washington	3	7
Slate, dark gray	0′ 5″			
Coal	0′ 8″	Lower Bench 2′ 0″		
Coal, better	1′ 4″			
Fireclay			4	0

Commercial mines in the Fairmont field of northern West Virginia.



Monongahela Series — Formerly called the Upper Productive Measures, the Monongahela Series is the youngest division of the true Pennsylvanian, extending from the top of the Waynesburg coal to the base of the Pittsburgh coal, a thickness of approximately 400 ft. The rocks of this series are composed of sandstone, shale, fresh-water limestone and coal. Of the eight recognized coal horizons in this series, four attain minable thickness and purity within the area.

Waynesburg Coal, named from its occurrence around Waynesburg, Pa., is mined only in Monongalia County at present. In Marion and Monongalia counties, where it attains its best development, it occurs about 410 ft. above the Pittsburgh coal. In this area it varies from 3 to 12 ft. thick, being always multiple-bedded and frequently divided into two benches separated by 1 to 36 in. of shale. The structure of the coal is well shown by the following section measured in Cass District, Monongalia County:

		Ft.	In.
Sandstone, massive, Waynesburg			
Shale, sandy	6′ 0″		
Shale, dark	0′ 6″	Cassville Plant Shale	6 6
Coal, bony	0′ 5″		
Coal	2′ 6″		
Shale, gray, 4″ to 2′ 6″			
Coal	4′ 7″	Waynesburg Coat	10 10
Coal, slaty	0′ 4″		
Coal	0′ 6″		
Slate			

Sewickley Coal, named for Sewickley, Pa., is mined commercially in Marion and Monongalia counties, where it occurs about 105 ft. above the Pittsburgh coal. This coal is here 5 to 6 ft. thick. Its double-bedded structure is well shown by the following typical section:

		Ft.	In.
Coal, upper bench	3′ 0″		
Slate, shale, or limestone 1″ to 0′ 4″			6 0
Coal, lower bench	2′ 8″		

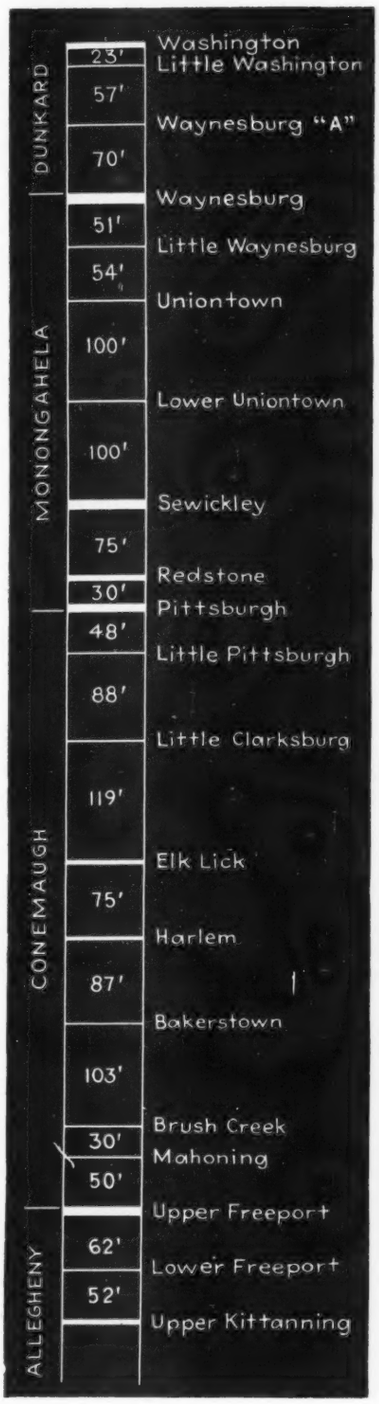
This coal is one of the most valuable commercial beds in the northern part of the field, although the physical characteristics are quite variable throughout the area.

Redstone Coal, designated from a stream of that name in Fayette County, Pennsylvania, is of minable importance in this field in northern Monongalia, northwestern Barbour and southern Harrison counties only, where it belongs from 25 to 30 ft. above the Pittsburgh coal. In Monongalia County, a small area of the coal attains an average thickness of about 5 ft. It is mined on a small scale only at present, but provides a suitable railroad and domestic fuel. The following section, measured near Randall, Monongalia County, shows the character of the coal in this area:

		Ft.	In.
Slate, dark			
Coal, good	3′ 1½″		
Slate, black	0′ 0½″		6 0½
Coal, good	2′ 10½″		

A small area of this coal has been mined commercially in southern Harrison and northwestern Barbour counties, producing a good steam and domestic fuel. It averages about 5 ft. in thickness and is a good grade of coal, often without partings.

Coal seams of the Fairmont Field.



Pittsburgh Coal, named from its exposure in the hills around Pittsburgh, Pa., is by far the most important seam in the field. It outcrops along the western side of the Monongahela River and along its western tributaries as well as in the hilltops to the east. The general structure of the coal throughout the field is well shown by the following typical section:

		Ft.	In.
Drawslate			
Breast coal	top coal, bony 1′ 0″		
	coal 2′ 6″		3 6
Bands	bone 0′ ¾″		
	coal 0′ 6″		0 7½
	bone 0′ ¾″		
Bottom coal			4 6
Total			8 7½

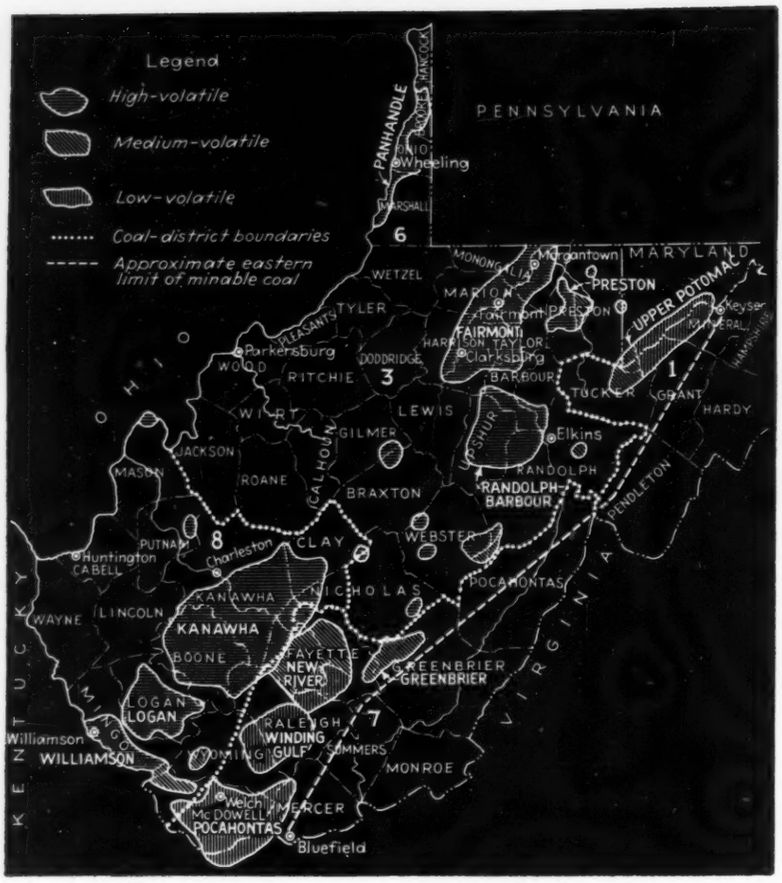
Conemaugh Series—Formerly called the Lower Barren Measures, the Conemaugh Series includes the strata from the base of the Pittsburgh coal to the top of the Upper Freeport coal, a thickness of approximately 600 ft. The rocks of this series consist of a cyclical arrangement of sandstones, shales, fresh-water and marine limestones and coals. Of the 21 recognized coal horizons in this series, only three attain minable thickness and purity in this field and the minable occurrences of these are very scattered and spotty.

Elk Lick Coal, named for the village of Elk Lick, Somerset County, Pennsylvania, belongs from 230 to 250 ft. below the Pittsburgh coal. It attains a thickness of 2½ to 3 ft. in a small area in Monongalia County where an attempt once was made, but with little success, to mine it commercially.

Harlem Coal, named for Harlem, Carroll County, Ohio, is mapped as attaining minable thickness and purity in the southeastern part of this area, where it occurs about 330 ft. below the Pittsburgh seam. It seldom, however, has a thickness of more than 2 ft. and will be of no commercial importance for several years.

Bakerstown Coal, named for Bakerstown, Allegheny County, Pennsylvania, while of some importance as a coal in other parts of the State, is far too irregular and patchy in this field to be of more than very local value. It belongs about 415 ft below the Pittsburgh coal.

Allegheny Series—Formerly called the Lower Productive Measures, the Allegheny Series is similar in character to the overlying series except that it contains more sandstone and



Coal-producing areas of West Virginia.

fireclay. Of the seven recognized coal horizons, only two attain minable thickness and purity, and these are confined to a narrow strip along the eastern edge of the field.

Upper Freeport Coal, named for Freeport, Armstrong County, Pennsylvania, and belonging about 600 ft. below the Pittsburgh coal, is a multiple-bedded seam having the following general section:

		Ft.	In.
(1)	Top coal	1′ 6″	
(2)	Main bench	2′ 10″	
(3)	Parting, "Little Slate"	0′ 2″	12 0
(4)	Lower bench, "Mining Pty"	1′ 3″	
(5)	Parting, "Big Slate"	5′ 0″	
(6)	Bottom coal	1′ 3″	

Nos. 2 and 4 of the above section are very low in sulphur and are used for high-grade coke.

Upper Kittanning Coal, named for Kittanning, Armstrong County, Pennsylvania, averages around 3 ft. in thickness in this area and occurs about 715 ft. below the Pittsburgh seam. It is double-bedded with a slate parting about 10 in. from the bottom and often has a layer of cannel slate at the top. The following general section shows its structure in this field:

		Ft.	In.
Coal, good, soft	2′ 6″		
Slate, gray 1″ to	0′ 2″	3	6
Coal, good	0′ 10″		

Producing Mines—The report of the West Virginia Department of Mines for the first quarter of 1939 shows that there were 67 commercial mines operating in the Fairmont field at that time and that they practically all were drift mines. Sixty of these mines, recovering the Pittsburgh seam, produced 4,787,362 tons of coal in 2,845 working days. The five mines in the Sewickley seam produced 400,504 tons in 225 working days; the one mine in the Upper Freeport, 89,539 tons in 60 working days; and the one mine in the Redstone seam, 23,428 tons in 22 working days.

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Typical mine exposures of the Sewickley (left) and Pittsburgh (right) seams.

Loading machine at work on a pillar in about 5½ ft. of Sewickley coal, Bunker mine.

MINING METHODS AND MECHANICAL LOADING

+ In Northern West Virginia

ALTHOUGH the Fairmont field of Northern West Virginia was one of the earliest regions to experiment on a sizable scale with the then new-fangled idea of loading coal with machinery, and purchased a number of loading units between about 1920 and 1924 in particular, it was not until 1936 that it went over permanently to the mechanized side. Mechanical difficulties and relatively low wage scales resulted in the rapid elimination of all the earlier loading machines and conveyors in the district beginning about 1925, and when these were gone no new loaders appeared until 1935.

Monongalia County was the scene of the new start in northern West Virginia mechanization, six machines in that county producing 290,379 tons in 1935, according to the West Virginia Department of Mines. By 1936 the number of machines—all mobile loaders—had increased to 51 and the tonnage to 2,258,373 (Monongalia, Marion, Harrison and Barbour counties). In 1937, the four-county total was 4,806,645 tons. Taylor County was added to the list in 1938, when 93 mobile loaders produced 6,304,999 tons. By July, 1939, when *Coal Age* started its survey of mechanized mines in Monongalia, Marion, Harrison, Barbour and Taylor counties, the number of loaders had increased to approximately 110, of which about ten were classed as spares. Production continued to rise in the first half of 1939 in spite of the suspension in April and May to a total of 3,445,109 tons in the five counties, with Monongalia still leading with 2,109,494 tons.

Annabelle, in Marion County, probably was the scene of the first attempt at mechanical loading in northern West Virginia. Here, the Four States Coal & Coke Co. tried out an Ingersoll-Rand heading machine in 1911. This machine was designed not only to load coal but also to break it down. However, it was not until after 1920 that loading equipment—both mobile loaders and conveyors—began to be adopted to any great extent. And then, after a spurt for a few years, the process of elimination began as noted above.

It is only fair to state that conveyors, however, never were numerous. A V-system, using special Fairmont conveyors, was installed at the Rachel (W. Va.) mine, one of the several operations of the Bertha Consumers Co., in 1924. Bertha Consumers, headed by John H. Jones, had purchased mobile equipment, including the first Joy used in a coal mine, as early as 1921, and now the Rachel mine, under the ownership of Jones Collieries, Inc., again is back in the mechanized class, not only with mobile loaders but also pit-car loaders and rubber-tired haulage equipment. Mr. Jones installed the first Joy units, 4 BU's, in the Eureka mine, along with two Myers-Whaley shovels. Now the Emily mine of the Monongahela Rail & River Coal Corporation, the opera-

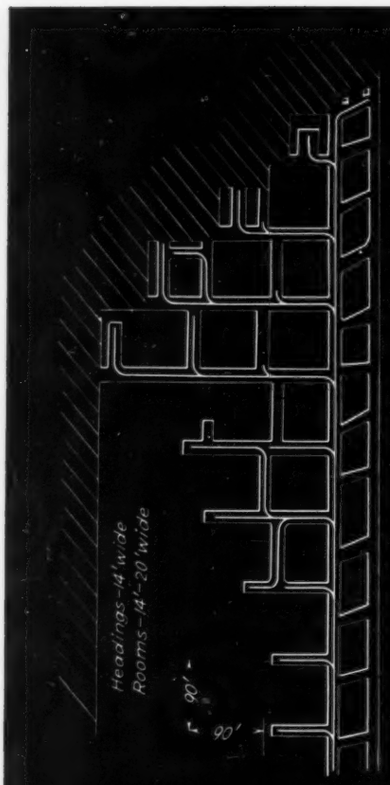


Fig. 1—General mining plan, Sewickley seam, Bunker mine.

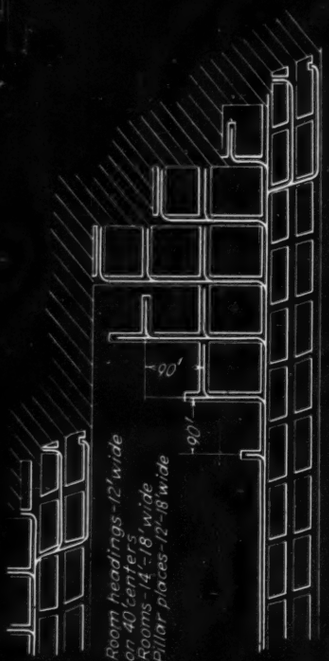


Fig. 2—Pillar mining on a 45-deg. line in a room territory in Continental No. 4 mine, Sewickley seam (shown diagrammatically).

Fig. 4—Diagrammatic sketch of working plan at Glen Cambria mine.

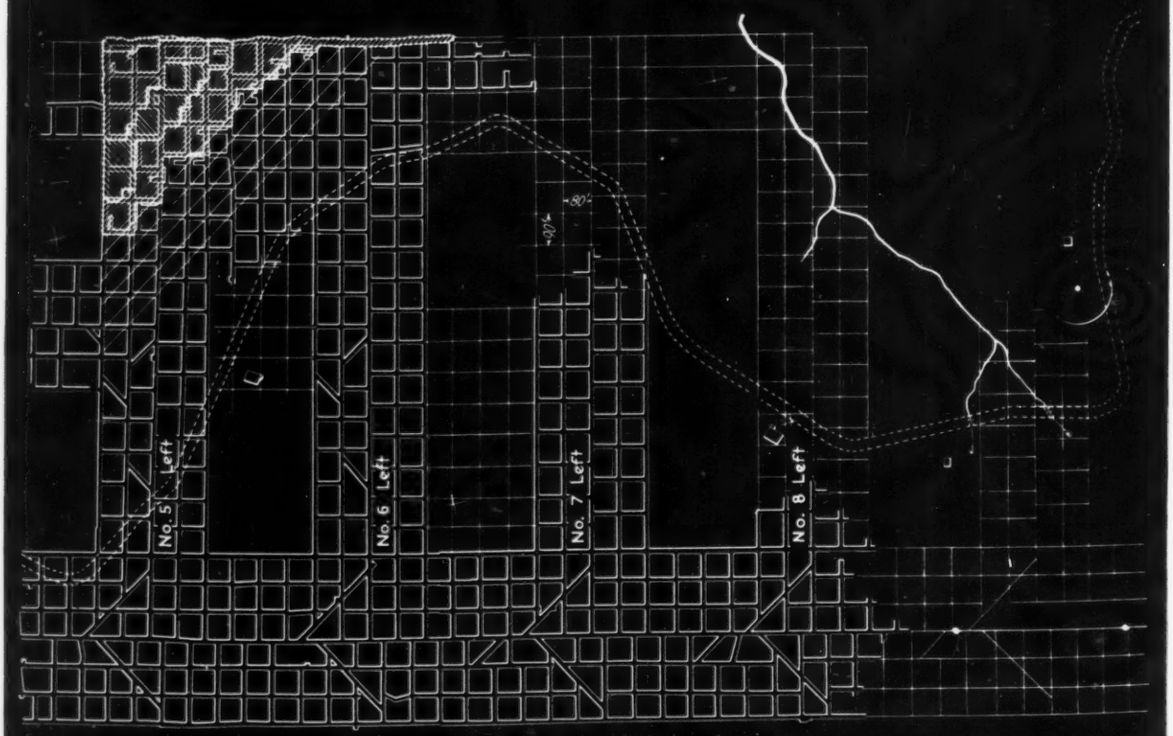
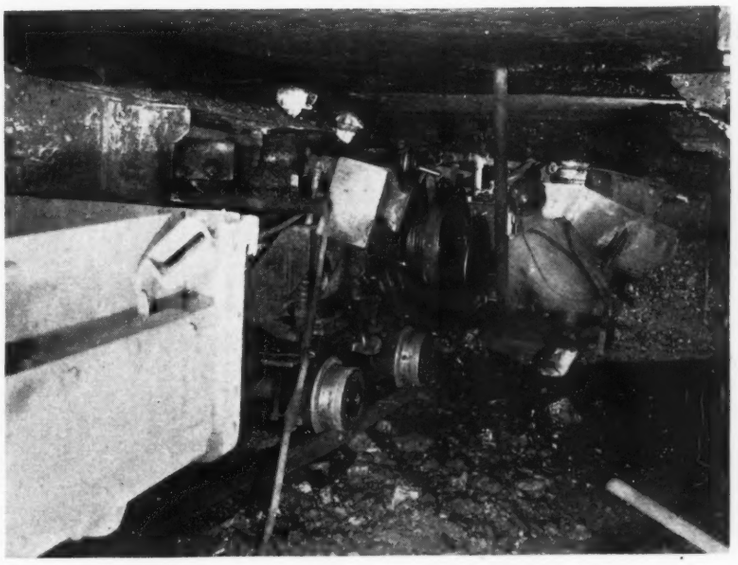


Fig. 3—Example of the block system of development and recovery of Pittsburgh coal at Jamison No. 8 mine.

tion again is back in the mechanized class with Whaley "Automat" loaders.

Another conveyor installation was that of the Connellsville By-Product Coal Co., in the Scotts Run region of Monongalia County. In this case, equipment consisted of a Jeffrey 44-B self-loading conveyor on a long face discharging into a 57-A sectional conveyor which in turn placed the coal in the mine cars. The mine now is incorporated in the No. 15 operation of the Pursglove Coal Mining Co., completely mechanized since 1935 with mobile loaders. Some fifteen years ago, the Bunker mine on Scotts Run, now a full-mechanical mine of the Davis-Wilson Coal Co., was equipped with a Riley loading machine working on a 200-ft. face. Examples of other operations which originally tried mobile loaders and now are back in the fold might be offered, but those already mentioned suffice to indicate an early mechanization movement of some strength.



Sewickley-seam recovery at Louise mine is now mechanical.

Loaders Cut Cost

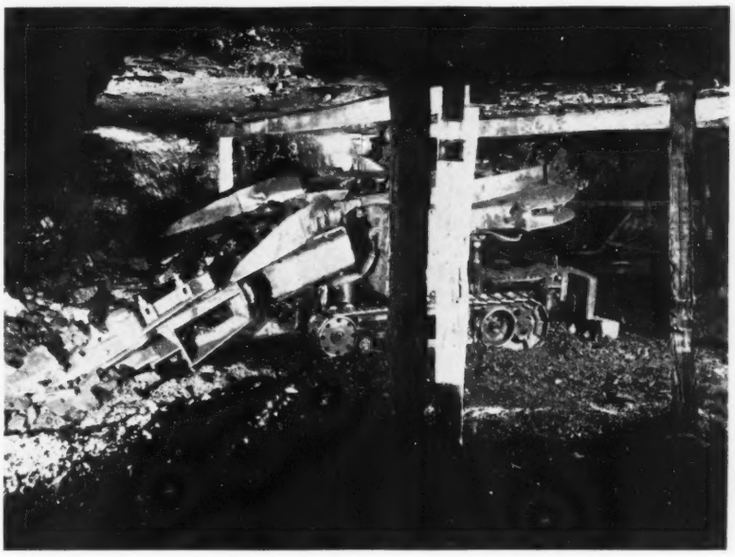
While other reasons, such as improvements in equipment, etc., played a part in the rebirth of mechanical loading in northern West Virginia, the major factor was increasing wage rates, which forced the adoption of machinery to prevent a rise in mine prices and consequent loss of business. But with the critical moment at hand, somebody was needed to break the ice. This was done by H. W. Showalter, Frank E. Christopher and their associates.

The C. L. S. Coal Co., organized by Frank and Lee Christopher, R. A. Layton, and Dean, E. M. and Brock Showalter, opened Robinson Run No. 1 mine, Maidsville, Monongalia County, in August, 1934, and installed a trial loading machine early in February, 1935. The operation, by then equipped with Joy loaders, was taken over later that year by the Christopher Mining Co., a purely Christopher organization, which worked it out in October, 1938, after producing more than 1,800,000 tons, and replaced it with the new Robinson Run No. 2, in addition to other old mines since taken over. The Monongahela Rail & River Coal Corporation was organized in 1934 by H. W. Showalter and associates to take over the old Eureka mine, near Maidsville, which was rechristened the Emily and started up March 1, 1935, with Whaley "Automat" loading machines. Later in 1935, Pursglove joined the mechanical-mining ranks.

Having reviewed developments from the standpoint of equipment installations it now becomes pertinent to determine what the results have been. One way is to compare the efficiency of purely hand with purely mechanical mines from the standpoint of output per underground employee per shift. In 1938, calculating from data in the report of the State Department of Mines, nineteen mechanical mines in Monongalia, Marion, Harrison, Barbour and Taylor counties worked 623,604 man-shifts in producing 6,151,214 tons, making the average output per man employed underground 9.86 tons per shift. On the other side, 42 hand-loading mines in the same five counties worked 1,148,446 man-shifts in producing 7,289,589 tons, making the average output per man underground 6.35 tons per shift. It will be noted that several partly hand-partly mechanical mines have been excluded from this comparison. Coal thickness taken at mechanized mines normally runs 4 to 8 ft., with most in the range of 5½ to 7 ft.

Some seventeen completely mechanized mines were covered in the *Coal Age* survey in July and August, 1939, the difference between the number in that period and 1938 representing closed, worked-out or consolidated operations only partially off-

This big machine, tearing into the coal on a pillar line, is recovering the Pittsburgh seam at Federal No. 3 mine.



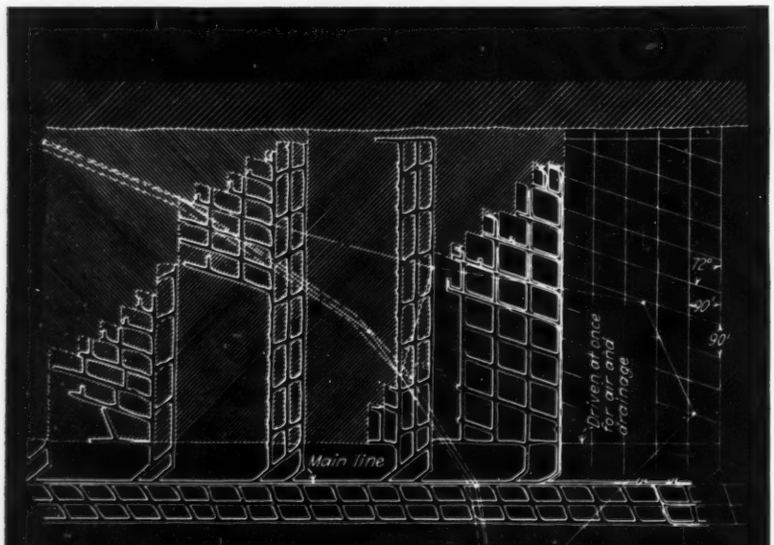


Fig. 5—Mining plan at Mona, showing use of angle openings.

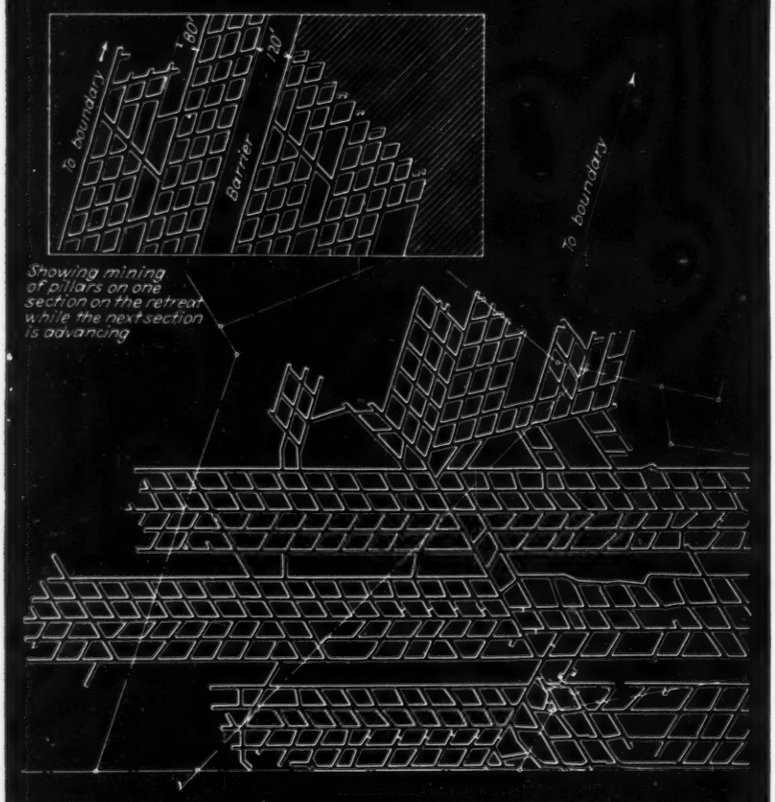

To boundary
Barrier
To boundary
Showing mining of pillars on one section on the retreat while the next section is advancing

Fig. 6—Section of mine workings, Robinson Run No. 2 mine, showing main entries and places being driven to develop working territories. Also shown is the contemplated method of mining pillars on the retreat.

set in number by new mechanical properties. Answers to questions as to (1) the average number of employees charged to underground operation per day and (2) the average daily tonnage shipped showed that an average of 2,861 men were employed underground per day to produce 35,730 tons. On this basis, the average output per man-day at that time was 12.5 tons. Curiously enough, this is exactly the same as the average output of 12.5 tons per man-day shown by the *Coal Age* survey of mechanized mines in Indiana in 1938 (*Coal Age*, December, 1938, p. 43).

200-250 Tons Per Shift

But while northern West Virginia underground efficiency is identical with Indiana, the output per loading-machine shift is, on the whole, appreciably lower, even though the working height, taking the region as a whole, probably is greater. Average output per machine shift in northern West Virginia runs as low as 150 tons, and in very few cases, except in those mines using rubber-tired haulage equipment, is the average more than 300 tons, as compared, for example, to many mines in Indiana and the remainder of the Middle West reporting averages of 500 tons or more per shift. As a rule, loading machines in northern West Virginia get out between 200 and 250 tons per shift.

While other factors, such as smaller crews, play a part in the lower loader performance in northern West Virginia, as compared with the Middle West and other long-mechanized regions, a major reason is inherent natural conditions. In other words, bad top in most of the northern West Virginia operations makes it necessary to drive narrow openings, with the result that, in spite of the widespread use of long cutter bars, output per place seldom exceeds 25 tons, as compared with 40, 50 and 60 tons in coal of comparable thickness in mines in the Middle West. Consequently, loader moving time is increased and production correspondingly decreased. In addition, pillars invariably are recovered in northern West Virginia, and while smooth-working pillaring systems are the rule, certain inherent disadvantages, such as working against falls, abrupt turns into pillar places, the

necessity for stopping to change or set timbers, etc., show up in loader performance.

Small cars inherited from hand-loading days are another handicap to a number of northern West Virginia mines. This handicap, however, is well recognized and there is an active interest in the installation of larger units, with some operators setting the goal at 10 tons. Two-locomotive changing, another method of eliminating to some extent time lost in serving loading machines, has not made a great deal of headway, principally because of the cost of the extra tracklaying that would be involved in making it really effective. Many operating men doubt the possibility of recovering this cost, particularly since, with the usual system of pillar recovery, many of the back switches required would be useless in this operation and thus much of the advantage of two-locomotive changing would be lost for a large part of the tonnage. However, four mines at the time of the *Coal Age* survey had cut the Gordian knot by installing two and three rubber-tired haulage units behind a loading machine, thus at one fell swoop getting the advantages of a larger capacity and quicker changes, in addition to eliminating tracklaying and track materials.

Concentration Helps

Achievement of a high performance per man employed underground in spite of a relatively low loading-machine output is due practically entirely to the high concentration secured in northern West Virginia mechanized mines, plus double- and triple-shifting to increase still further the tonnage from a group of working places. The degree of concentration in some cases is almost startling when it is considered that a total of ten to fourteen working places on two butt, or room, entries may produce 1,400 to 1,500 tons per day, this with an output of only 25 tons per cut.

With such a large tonnage from such a small working territory it readily can be seen that the indirect labor required to service the working areas can be sharply reduced. In fact, most loading-machine units in northern West Virginia are set up on the basis of only 5 to 7 working places and a number of operating men pride themselves on their ability, when conditions require it, to get nearly the usual tonnage out of only two working places. However, extremely accurate coordination is required, even with five to seven places, to prevent interference between loaders, cutters, drillers, tracklayers, timbermen, shotfirers, etc., and the difficulty of securing such coordination has led in some quarters to a belief that a few more working places would help.

Four of the mechanized mines covered by *Coal Age* are in the Sewickley seam in the Scotts Run region of Monongalia County. Two of these operations are reached by drifts, one by a mine-car slope and the fourth by a combination of man-and-material shaft and mine-car slope. Overlying the Pittsburgh seam some 60 to 100 ft., the coal in these four operations ranges from 4 to 6½ ft. in thickness, with the average around 5 to 5½ ft. All of this thickness is taken and in the case of Pursglove No. 2 mine, Pursglove Coal Mining Co., main entries are columnized with those in the No. 15 mine in the Pittsburgh coal below. In addition, Sewickley mining is kept ahead of the Pittsburgh to insure complete extraction before the coal can be disturbed by pillaring in the underlying Pittsburgh.

Rooms Driven Wider

In two of the Sewickley mines the roof was reported as slate and fairly good in character. In another, the report was 0 to 3 ft. of drawslate replaced in spots by sandstone, with the latter signifying bad conditions. In the fourth operation, Pursglove No. 2, a variable roof is encountered, ranging from sandstone and limestone through drawslate, blackjack, etc. Except in the latter operation, the somewhat better nature of the Sewickley roof permits some increase in room width, as compared with the Pittsburgh seam. Underneath the Sewickley is fireclay. As some of the mines are distinguished by considerable outcrop, the cover ranges from 0 up to 800 ft., the latter being the maximum at Continental No. 4, Continental Coal Co.

"Head Coal" Left

All other mechanized mines surveyed in northern West Virginia are in the Pittsburgh seam, which varies in these operations from 6½ to 9 ft. in total thickness. In only one case, however (Eagle mine, Getty Coal Co., in Harrison County), is the seam usually mined completely, as the common practice is to leave up from 6 to 24 in. of "head coal" to hold the top, which generally is drawslate. As a rule, a definite parting between the main part of the seam and the head coal is present, facilitating the separation where top shooting is done. Another reason for leaving "head coal," except where it comes down unavoidably, is the fact that it normally is of a lower quality. Also, about 4 to 6 in. of coal usually is left in the bottom in Pittsburgh-seam mines, both because of poor quality and as a protection against digging into the fireclay which normally underlies the seam and varies from hard to soft, depending upon mine and locality. Consequently, the thickness mined runs from only 5½ to 7½ ft. The usual thickness in Monongalia County is reported as 6 or 6½ ft.; in Marion and Harrison counties, 6½ to 7½ ft.

While the nature of the members comprising the immediate roof over the Pittsburgh coal in the area in question is subject to some variation, in almost all cases the seam is over-

Track-mounted loading machine starting a pocket through a pillar in Pittsburgh coal, Mona mine.

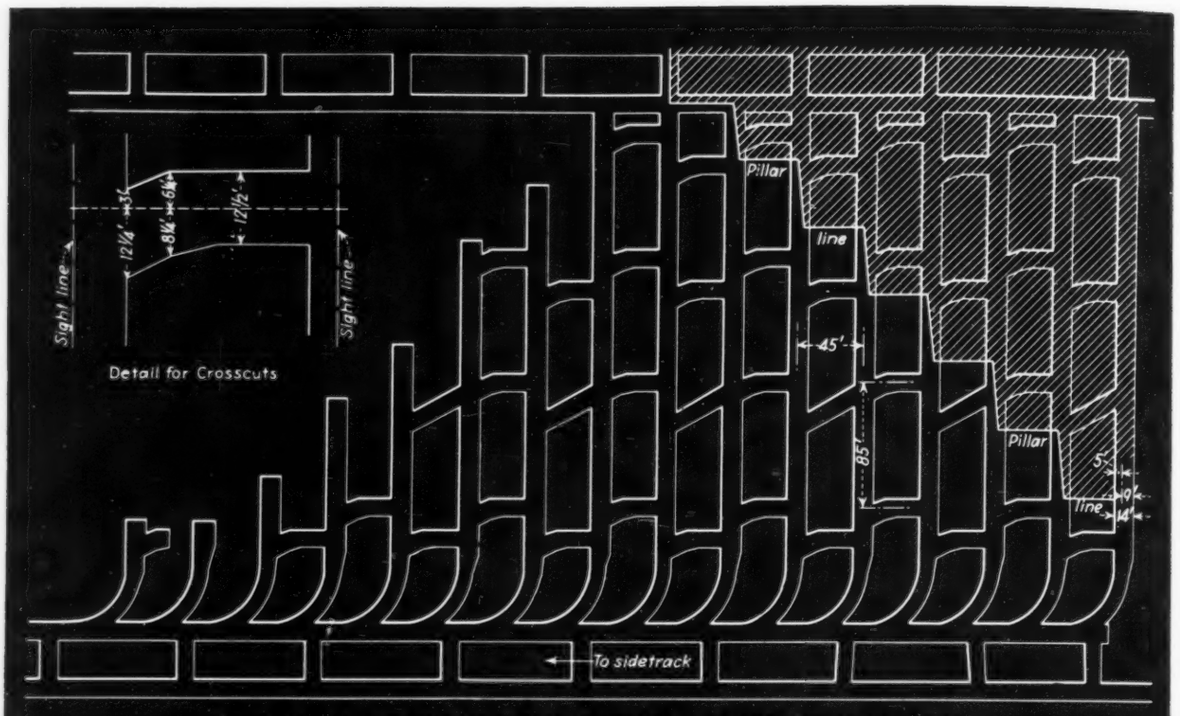


Fig. 7—Typical room-and-pillar sections for mechanical loading, Dawson No. 2 mine.

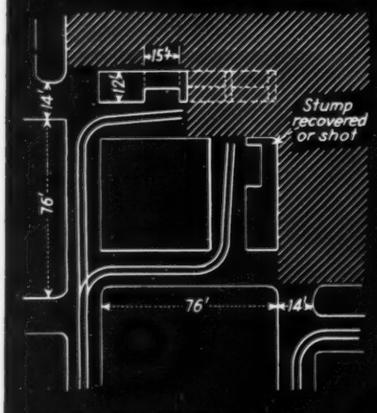


Fig. 8—Pillar-mining plan, Bunker mine.

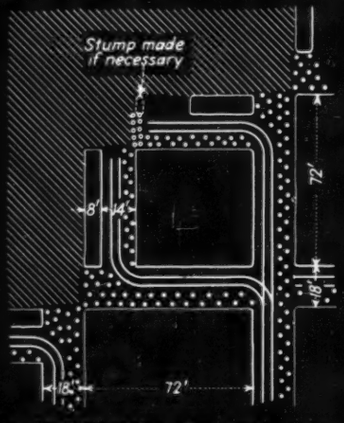


Fig. 9—Pillar-mining plan, Louise mine.

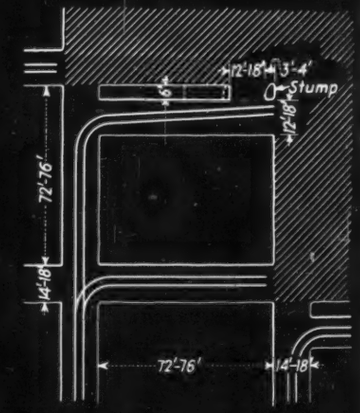


Fig. 10—Pillar-mining plan, Continental No. 4 mine.

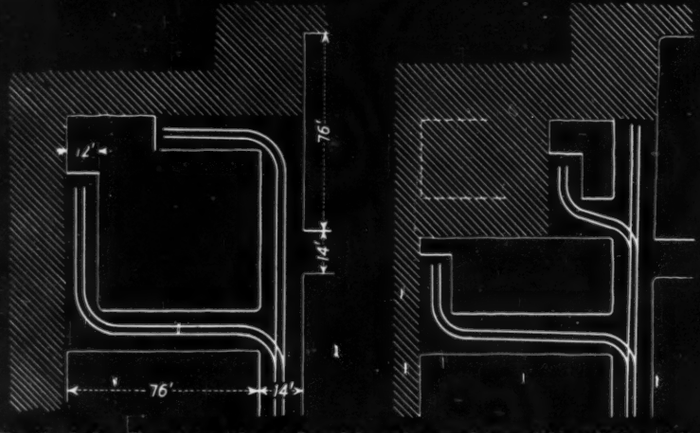


Fig. 11—Left, pillar-mining plan at Rosedale under good top; right, splitting plan used under light cover and weak top.

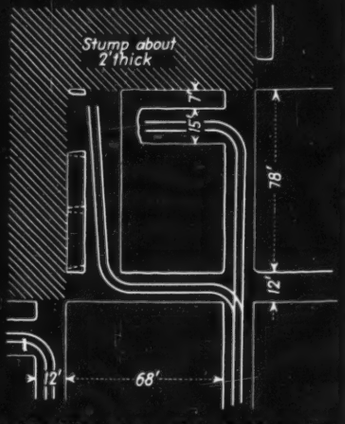


Fig. 12—Pillar-mining plan, Jamison mines (blocks slightly longer than wide).

laid by drawslate, replaced by shale in one mine. Where present, the drawslate sometimes thins down to an inch or two, but usually it seldom is less than 6 in. in thickness, normally running up to 18 or 24 in., although 8 to 10 ft. is reported in one case. Over the drawslate is a "rooster coal" in most operations, although it disappears in one or two properties covered in Harrison County and appears only occasionally in a few mines in other counties. Commonly, however, there is about 8 in. to 2 ft. of "rooster," which may underly the main roof or instead may have over it another layer of drawslate, etc. In any case, the coal generally is overlaid by a weak and treacherous member or series of members, which accounts for the almost universal practice of leaving "head coal," which normally is very efficient in preventing falls. And with the rise of mechanical loading the same condition has resulted in regulations that at least two crossbars be carried at the face at all times.

Drifts in Majority

Pittsburgh-seam mines covered by *Coal Age* run the gamut of shaft, slope and drift openings, with the latter in the majority, although a general dip of the measures of 1 to 1½ per cent in a westerly direction made it necessary for several mines to sink slopes and shafts. And where slope or drift openings are possible there is more or less outcrop, which plays its part in influencing mine projections. Incidentally, the dip forces most of the mines studied by *Coal Age* to haul part or all of their coal uphill, particularly in Monongalia and Marion counties, where the most feasible outlet usually is toward the Monongahela River to the east. Cover over the coal naturally varies from 0 at the outcrop to 800 ft. or more at some of the more westerly shaft operations. And along the Monongahela River and in certain other areas where the seam goes up into the hilltops the cover may never exceed 100 or 150 ft. The average at most mines, however, ranges from about 250 to 400 ft.

The so-called "block" system of extraction usually is employed at all but one of the mines visited by *Coal Age*. Another operation, however, was planning a change to short centers in connection with rubber-tired haulage, while in one or two cases the mining plan is difficult to fit into either the "block" or "room-and-pillar" category. Block plans studied were of two general types. In one, which might be called the "100-per-cent block" system, all openings (rooms, entries, etc.) are driven on the same, or nearly the same, centers to divide the coal into square, or nearly square, blocks. In the other, a modification based on the use of regular short-centered butt, or room, entries but with wide room centers to provide the desired blocks is employed. In the latter, the usual mining territory is made up of square, or nearly square, blocks plus narrow chain pillars. Also, retreat operation, either complete over the mine or locally within a room territory, is the almost invariable practice.

The four Sewickley-seam mines furnish examples of operations based both on territories defined by room entries driven at regular intervals and also on combinations of room blocks and narrow chain pillars; i.e., what might be termed the "modified-block" system. At the Bunker mine, for example, 5 to 5½ ft. of coal, room entries comprising two or three headings 14 ft. wide on 50-ft. centers are used to develop a working territory. When these headings reach the boundary or other limit, driving rooms (14 to 20 ft. wide on 90-ft. centers) and mining pillars is begun, the latter on a 45-deg. line, as indicated diagrammatically in Fig. 1.

Rooms at Bunker, using one 7BU and one 8BU loading machines, are turned one way and the usual depth is 300 ft. Normally, these rooms drive up against a territory already mined and caved. It will be noted (Fig. 1) that rooms are driven in about 75 ft. as the entry is advanced, this practice, plus entry crosscuts, providing from three to five working places during this cycle. In retreating, rooms are extended as needed and the total number of solid plus pillar places also is around five.

Rooms also are driven part way up (about 40 ft.) at the Louise mine, Louise Coal Co. (5-ft. coal). Thus Bunker and Louise, plus one or two other operations, become the only ones among the mechanized group in northern West Virginia to indulge in this practice. Room entries at Louise are made up of two headings 15 ft. wide on 40-ft. centers, the two headings plus crosscuts and room necks providing about four places (average) on the advance. Retreat operation is much the same as at Bunker; i.e., the section is pillared down to the entry on a 45-deg. line, whereupon the loading machine goes ahead to start a new territory. As compared with Bunker, however, room width is 18 ft. and depth normally is 250 ft. Centers, however, are the same at 90 ft. and in retreat (or pillar) work the usual number of places is four or five. Equipment at Louise includes two 8BU and one Jeffrey 44-D loading machines. Both Bunker and Louise employ a few hand loaders for clean-up, getting stumps, etc., which practice also is followed at a few other operations in the region.

Three headings 12 ft. wide on 40-ft. centers comprise a room entry at the Continental No. 4 mine. Room width usually is 14 to 18 ft.; depth, 300 ft. or less; and centers, 90 ft. Rooms, as at most other mines employing room entries, are turned one way and as the room entry starts out, the first two rooms are driven through as auxiliary airways. The entry then is driven to the limit and about three rooms are started on the inby end. When these rooms are up, pillaring on a 45-deg. line is started (Fig. 2). When this stage is reached, working places total five or more—part pillar places and part new rooms being driven up. Coal thickness averages 5½ ft. and cars hold 3 tons. Loading equipment comprises six 7BU Joys and one Jeffrey 44-D. One 7BU is kept as a spare in addition to the six in use. Joy crews comprise twelve men, including the boss, with one more man on the 44-D machine. Daily output was 2,500 tons (eleven machine-shifts).

Machines Aid Pillaring

Pillaring at Continental No. 4, however, has been the practice only since the installation of loading machines. The fireclay bottom at the mine is soft and under hand-loading conditions pillar extraction was slow, which resulted in heaving and stoppage of work. Faster extraction now makes it possible to pillar before heaving starts. Continental No. 4 also is distinguished by a dual bossing system, under which a face boss over each crew gets out the coal, while safety, etc., fall to an assistant foreman, usually one for each two loading crews. This arrangement has materially reduced injuries.

The same mining plan is used in the Sewickley at Pursglove No. 2 mine as in the underlying Pittsburgh seam in Pursglove No. 15. Consequently, headings and rooms both are driven only 12 to 14 ft. wide. Three headings comprise a room entry and are driven on 60-ft. centers. Room centers, on the other hand, are 80 ft. and the practice is to drive up the room entry and then start advancing rooms and mining pillars on a 45-deg. line on the retreat. Sewickley thickness in No. 2 varies from 4 to

Starting a new working place in Pittsburgh coal with a track-mounted loader, Emily mine.

5½ ft. and eight low-pedestal 7BU machines are in use, including a new unit which went into service Nov. 1, 1939. Production with seven machines averaged 3,000 tons per day (seventeen machine shifts, 2½-ton cars) and 231 men were employed underground.

Pursglove No. 15 mine results from consolidation of the old Nos. 1 and 5 operations. This consolidation had just been made at the time of the *Coal Age* survey, when ten 7BU machines were in operation in 6 ft. 2 in. of coal—the average height taken. Average output per day was 2,500 tons (seventeen machine-shifts, 2¾-ton cars, usually ten-man crews), with 222 men underground. With normal conditions established, expected output is 3,000 tons per day with the same men and machine-shifts.

With a hilltop operation entirely surrounded by outcrop, the Rosedale Coal Co., recovering 7 ft. of Pittsburgh coal in Monongalia County, also makes a practice of necking rooms, although no switches are laid, on the advance. Room entries consist of two headings 12 ft. wide on 50-ft. centers. Rooms about 300 ft. deep and 14 ft. wide on 90-ft. centers are turned one way and the pillars mined out on a 45-deg. line on the retreat. Number of places on retreat usually is five or six. Four 11BU loading machines with eleven-man crews were in service getting out 3,000 tons per day of twelve machine-shifts, using 2¼- and 4¼-ton cars. Total number of employees underground was 250, including a few hand loaders in clean-up work.

Room entries at Rachel mine, a shaft operation in the Pittsburgh seam in Marion County, consist of two headings 12 to 14 ft. wide on 60-ft. centers. Room width is the same, but room centers are 80 ft., while the usual depth is 240 ft. Retreat pillaring on a 45-deg. line is the practice here also, and 6½ to 7 ft. of coal is taken. Working territories are made up of four to eight places. Equipment includes four 7BU loaders with a fifth as a spare and six La-Del pit-car loaders with a seventh spare. The pit-car loaders supplement the loading machines in pillar work, primarily in the recovery of stumps. With this equipment and an underground force of around 200 men, average daily output was 2,000 to 2,200 tons, of which approximately 85 per cent was derived from eight loading-machine shifts and the remainder from the pit-car loaders.

Pittsburgh-seam mines using nominally "100-per-cent block" systems may be divided roughly into two classes. In one class, all rooms are driven on the advance to the boundary, whereupon pillaring on—most often—a long continuous line is done on the retreat. Emily mine offers an example of this system. Taking about 6 ft. of coal, this operation drives all places on 94-ft. centers, with openings serving as headings 12 ft. wide and rooms 14 ft. wide.

Three Whaley No. 3 and No. 4 size "Automat" track-mounted loading machines are employed at Emily and each machine has about six places on the advance, providing, with crosscuts, some six to eight working places. On retreat, the machines have about the same number of rooms, but, counting usually two working places to a pillar, the total number of faces is increased to about twelve. Twelve men is the minimum loading-machine crew, with extras as necessary, particularly trackmen and timbermen in pillar work. On this basis, Emily, with an average of 91 men underground, was producing about 1,400 tons in 5½ machine-shifts, using 5.2-ton cars.

A combination of advance and retreat mining is employed at the Maiden mine, Kelleys Creek Colliery Co., in Monongalia County, where about 6½ ft. of Pittsburgh coal is taken and sulphur balls weighing a ton or more, clay veins, bands and intrusions of pure rock complicate the work of extraction. At Maiden, the coal area is divided into sections, each served by a face entry (12-ft.-wide headings on 100-ft. centers). As the face entry advances into the section an area approximately 1,400 ft. wide, which is cut up into 100x92-ft. blocks by driving openings 14 ft. wide, is mined on the advance on one side of the section. When the limit is reached, retreat work starts, taking in about 300 ft. between the face entry and the area already mined, the face entry itself and a 200-ft. barrier on the other side.

A long 45-deg. pillar line eventually is formed at Maiden and the practice is to have one loading machine on every 300 ft. of this line plus other machines advancing the face entry and the necessary openings in the solid to provide new places. Consequently, machines in solid work have four working places plus crosscuts, while machines on pillar lines usually have six places. Nine 11BU loading machines manned by thirteen-man crews were in use in July, 1939, producing 4,000 tons of washed coal per day of eighteen loading shifts. Average employees underground was 300. Car capacity is 4 tons (shipped-coal basis).

Driving to the boundary, establishment of long pillar lines and outlining of blocks largely only as needed to keep sufficient pillar places is a distinguishing feature of extraction at the Federal No. 3 mine, Koppers Coal Co., Monongalia County, where 5½ to 6 ft. of Pittsburgh coal is taken.

In other words, a full-retreat system in all senses of the term is operated. Places at Federal No. 3 are driven 14 ft. wide on 100-ft. centers, thus providing 86-ft. blocks. With 112 men underground and three loading machines (two 11BUs and a trial track-mounted unit), average daily production at the time of the *Coal Age* survey (six machine shifts) was 1,200 tons. Counting only men on the loading crews, production at this mine has ranged from 17 to 20 tons per man-shift. At the Federal No. 1 property, in Marion County, three Joy machines were in service driving entries and doing other development work and were producing 20 to 25 per cent of the average daily output of 7,500 tons. In September, these 7BU loaders, with eleven-man crews, were averaging 295 tons per shift in solid work (14-ft. places).

Retreat in Panels

Operations at the Jamison Nos. 8 and 9 mines, Jamison Coal & Coke Co., Marion County, can be described most simply, perhaps, as retreat in panels with pillar lines continuing without stopping from one room territory to another. An example of this system of working, from the No. 8 map, is reproduced in Fig. 3. Territories are opened up by main entries made up of seven headings on 80-ft. centers, with haulage headings 11 ft. wide and others 12 ft. wide. Room entries comprise five headings, also on 80-ft. centers and 11 and 12 ft. wide. When these room entries are driven up, pillaring starts on a 45-deg. angle, with new places being driven only just fast enough to replace those worked out. This synchronism, as a rule, also extends to room entries, which, as indicated in Fig. 3, are driven on a schedule which insures their completion at just about the time they will be needed. Pillar lines thereby may be kept going indefinitely, taking in one room entry after another.

Except for one Joy 8BU machine at No. 8, four to six working places, Goodman 260B and 360B track-mounted loading machines are used at Nos. 8 and 9 mines. A territory for one of these machines is five to ten places, with the usual bogey, particularly at No. 8, as eight to ten. Thickness taken at both properties is 7 ft. Car capacities vary from 2 to 3 tons.

The crew on the Joy unit comprises twelve men, while the minimum on the Goodman machines is fourteen or fifteen on the second shift when using one changing locomotive. On the day shift and using two locomotives, crews may run up to nineteen or twenty. With this set-up, No. 9 mine kept one 260B machine as a spare and used two 260s and one 360 two shifts a day for an output, at the time of the *Coal Age* study, of 1,300 to 1,500 tons, with a total of 125 to 130 men underground. At No. 8 mine, machines in use were: one 8BU, three 260s and one 360. With a total of ten machine shifts and an average of 250 men underground, daily output was 2,500 tons. Of this total, the Joy, twelve men, contributed about 150 tons per shift, and the 360, two locomotives, about 350 tons; one locomotive, about 250 tons.

Full retreat with all places on 90-ft. centers is the rule at the Eagle mine, Getty Coal Co., in Harrison County. Some 100-ft. centers also have been driven. A better-than-average top permits increasing width of openings to 15 ft., as compared with 12 to 14 ft. at most Pittsburgh-seam mines. Six places per loading machine is the rule, although the number may run as low as three or four or as high as ten. Commonly, the entire seam thickness of 8 to 8½ ft. is taken where conditions are good; where the top deteriorates, particularly in pillar mining, about 1 ft. of top coal is left. Mine cars have a capacity of 5 tons and loading units (two 10BU and two 11BU Joys) are operated by thirteen-man crews. On this basis, average daily output (eight machine shifts) was 1,800 tons with 160 men employed underground. Substantially the same system is employed at the Rosemont mine, Green Valley Coal Co., another Reppert operation in Taylor County. Here about 7 ft. of coal is taken and 3-ton cars are used. Two 7BU loading machines got out 600 tons (two machine-shifts) per day, with 65 men underground.

Two 11BU loading machines are used at the Glen Cambria mine, Mountain Fuel Co., in Barbour County. Working five shifts a day, they account for approximately 60 per cent of the normal tonnage of 900 to 1,000. Total seam height is around 8 ft.; usual working height is about 6½ ft. Frequent clay veins offer a troublesome problem, inasmuch as they normally must be loaded out. An eleven- to twelve-man crew is used in solid work and nine men in pillar work. Car equipment consists of 120 3-ton units and 100 new 5-ton cars.

Glen Cambria is a hilltop operation and consequently mining at present is based on driving room entries off a centrally located main to the outcrop and pillaring back on the retreat. Main entries comprise four headings 13 ft. wide on 50-ft. centers. Room entries, on the other hand, consist of two headings on 100-ft. centers. Room width is 14 to 15 ft., and all rooms and crosscuts are driven on 100-ft. centers. But while pillaring on the retreat is the general plan, a slightly different twist is given it at Glen Cambria. As the room entry advances, rooms are turned off one side and driven to their full depth, usually around 300 ft. Then pillaring is started on a 45-deg. line at the end of the last room and at the same time rooms are started on the other side of the entry so that they can be picked up when the pillar line crosses the headings. This system is shown diagrammatically in Fig. 4. When the pillar line gets down to the barrier along the main it is squared around and the

Finishing a stump with a pit-car loader, Pittsburgh coal, Rachel mine.

Track-mounted loader in the face in Pittsburgh coal, Jamison No. 8 mine.

rest of the blocks are taken out by hand.

The more or less "special" mining plans, exclusive of set-ups for rubber-tired haulage, which will be discussed at the end of this article, include those of the Arkwright Coal Co., Mona mine; Christopher Mining Co., Robinson Run No. 2, and the room-and-pillar system at Dawson No. 2 mine, Dawson Coal Co., all in the Pittsburgh seam. At Mona mine, in Monongalia County, all mining is concentrated in a small section just above a single main entry made up of three 11-ft.-wide headings on 55-ft. centers. Normally, this section provides two working territories for two loading machines; one machine, when it completes a territory, moving ahead to advance the main entry and start a new territory.

Considerable experimentation since August, 1937, has evolved the mining plan shown in Fig. 5. The Mona management started out with rooms 11 ft. wide on 60-ft. centers turned at an angle of 90 deg. Later, the rooms were turned 72 deg., still retaining, however, the same heading standards. Number of headings then was increased to three on 40-ft. centers, to be followed by a new plan in which all openings, regardless of their character, are driven 13 ft. wide on 90-ft. centers, with the exception of the outside, or No. 1, room heading, 11 ft. wide. In this evolution, the management also changed from full retreat to the practice of driving rooms on the advance and mining the pillars on the retreat, this system insuring an adequate number of working places while developing. By turning rooms at 72 deg. instead of 90, easier access to all places was assured, while at the same time the angle places are not too far off the face cleats to affect shooting and loading. Furthermore, increasing room centers resulted in a larger block adaptable to mining from two working places a large part of the time, thus raising the number available in pillaring back. Cutting the working places at an angle also facilitates drainage.

Summarizing, therefore, a room territory at Mona is started by driving three places off the upper side of the main (see Fig. 5). As soon as they are in far enough, what corresponds to No. 1 room, turned 90 deg., is driven through immediately to facilitate ventilation and drainage. Then solid work is carried on to the limit of the territory, whereupon pillaring is started on a 45-deg. line on the retreat. Under this system, about six working places usually are available for a loading machine, although at times, such as when starting pillar mining, the number may get down to two or three. Two Jeffrey L-400 track-mounted loading machines are used at Mona, with a third as a spare. Unit crews consist of thirteen men, while the mine cars average 3 tons. With two machines working a total of six shifts a day, output ran 1,400 tons with 125 men employed underground.

Loading machines at Robinson Run No. 2 mine, Monongalia County, usually are provided with four or five places in a mine layout which puts all openings on an angle of 62½ deg., thus facilitating haulage and equipment movement. The main opening is made up of three groups of five headings each 12 to 14 ft. wide on 60-ft. centers. Thus, each heading group provides ample working places for one loading unit. Working territories are opened up by "entries" made up of eight headings in two groups of four each on 60-ft. centers. Each group is separated by an 80-ft. pillar. The practice is to drive four places 810 ft. and then, while heavy steel is being advanced, drop back and bring the other four ahead. But, if it should be desirable, the eight headings will permit two loading machines to be operated and still, with crosscuts driven 90 ft. apart, provide each machine with four to six working places.

As indicated in Fig. 6, the entries are extended to the boundary, leaving between each pair a barrier 120 ft. thick which may or may not be cut through on the advance, depending upon ventilation and other considerations. When an entry reaches the boundary it is planned to start mining 46x76-ft. pillars immediately on the retreat, probably about as shown diagrammatically in Fig. 6. This method is based on establishing a regular pillar line and recovering the barrier by extending the places already driven on into it.

Nine Loaders—5,500 Tons

With a total of five 11BU and four 10BU loaders on hand, of which seven were in regular use, Robinson Run No. 2 was producing an average of 5,500 tons per day (21 machine-shifts) at the time of the *Coal Age* study, employing 325 men underground. The 10BU machines, as far as possible, are used in pillar work, due to the 90-deg. swing available with the rear conveyor. About 6½ ft. of coal is taken and car capacity is 5 tons. Loading crews usually comprise twelve men.

Two Goodman 260-B track-mounted loading machines were in use at the Dawson No. 2 mine, Dawson Coal Co., Harrison County, at the time of the *Coal Age* survey, with additional machines on the way. In changing from hand to mechanical operation, Dawson retained one of the few "room-and-pillar" systems in the region, changing from 60-ft. room centers with hand loading to 45-ft. centers with machine loading. Usual room depth is 300 ft. and the practice is to drive room entries 9½ ft. wide on 40-ft. centers to their full depth (Fig. 7) and then start developing rooms and mining pillars on a 45-deg. line on the retreat. To date, the machines mostly have been used in territories where the entries already had been driven by hand.

Rooms at Dawson No. 2 are necked 10 ft. wide on a curve and then are

widened to 14 ft. The use of curves and also crosscuts at 60 deg. facilitates haulage and the travel of track-mounted equipment. Once started, a pillar line may, as indicated in Fig. 7, be continuous over several room entries. Taking about 6 ft. 9 in. of coal and using 3-ton cars, the Dawson loading machines were averaging about 225 tons per shift. Crews comprise fifteen men, including two tonnage men cleaning up, getting stumps, etc. Dawson also is unusual in the number of working places normally provided for a loading machine, generally twelve or thirteen.

It will be noted that in northern West Virginia the mining plans do not provide for loading machines solely for driving entries, with the exception of Federal No. 1 mine, where mobile machines are developing for hand loading. As a rule, units graduate from one type of work to the other without material change in personnel, width of places or other practices, although it has been found in a few cases, particularly where machines are new, that crews going into pillar work find the change-over a little difficult for a short time. And in view of the small number of places which most operating organizations consider a territory, as well as the small difference in width of openings as between headings, rooms and pillar places, there is little occasion to expect that production should be much different.

Pocket to Mine Pillars

Schemes for the extraction of an individual block, or pillar, as might be expected, vary with practically every mine. However, in general, it might be said that pillars normally are recovered (1) by driving successive pockets through from one or two sides, leaving either a thin fender against the gob or a subsidiary pillar thick enough for further operations, or (2), by splitting the pillar and following this by pocketing or open-ending. At Bunker mine, as an example of a pillar-extraction plan of the first type, 15-ft.-wide pockets are driven through blocks 70 to 76 ft. square from both sides, leaving 12-ft. subsidiary pillars against the gob. Pockets then are cut through these pillars (Fig. 8), leaving small protective stumps on the gob side, which are recovered, if possible, by machine or hand loading or, if not recoverable, are shot to prevent interference with roof action.

Substantially the same system is followed at Louise, except that the subsidiary pillars (Fig. 9) are only 8 ft., or about one cut, thick. As the 8-ft. subsidiary pillar, or fender, is slabbed back, breaker props, or breaker props and stumps, are left as protection while loading the succeeding slab. Both breaker timbers and/or stumps naturally are removed to promote caving of the roof, which follows cut for cut after the slabbing. In fact it might well be pointed out here that pillar extraction throughout all mines in northern West Virginia is based on getting a fall of roof after each cut is removed, as it is only thus that pillars can be mined with a minimum of difficulty from squeezing and crushing, falls in the solid work, loss of track and other materials and excessive use of timber, not to mention loss of coal. So a major duty of the face boss on any pillaring section is to see that stumps are removed or shot and that breaker and other timber is pulled to get clean falls after each cut. In some mines, such as Mona, Federal, Maiden and others, locomotives have been converted into timber pullers by disconnecting one motor from the axle and using it to drive a drum to pull props and bars by means of a wire rope. Speed, remote operation and plenty of power are the major advantages of such post-pulling equipments.

Pocketing through from one side and leaving a fender 6 ft. thick is the practice at the Continental No. 4 mine. This fender then is mined, as shown in Fig. 10, by slabbing cuts 12 to 18 ft. long. Stumps, in accordance with the usual practice, are recovered or shot.

Straight open-end recovery of blocks 76 ft. square by driving across two sides is the practice at the Rosedale mine (Fig. 11) where the top is good. Where the cover is thin and the top is weak, the blocks are split through the middle and then pocketed out. At Rachel mine, however, the system again is pocketing through from two sides, leaving a fender about one cut thick for subsequent operations. The fender on one side is removed before the pocket on the other comes through. Some such method of synchronizing pocket driving and fender recovery also is practiced at certain other mines. Rachel also has departed from the practice at all other mines by installing seven La-Del pit-car loaders (six in use) for taking out stumps in pillar work and for use in other places where it is not felt safe or economical to put a loading machine. With two-man crews, these six pit-car loaders, working twelve shifts a day, get out 300 to 350 tons.

Jamison Nos. 8 and 9 mines also pocket through from two sides and leave a fender about one cut through. This fender is worked out by slabbing and leaving small stumps, as shown in Fig. 12. At Jamison, blocks usually are slightly longer than wide, which gives a better balance in driving through toward the end. At the Glen Cambria mine, pockets (Fig. 13) are driven from one side only, leaving a thin fender primarily to keep gob out of the working place. The fender also acts as a substantial roof support and materially reduces the timber required. As in the case of stumps, it is removed or broken down where necessary to prevent interference with roof action.

Recovering a 46x76-ft. diamond-shaped pillar at Robinson Run No. 2 consists of pocketing 14 ft. wide across the end, leaving a thin fender against the gob, until the pillar is worked down to a triangle. Pockets then are driven through this triangle as in Fig. 14, leaving small stumps

Dawson No. 2 mine also recovers the Pittsburgh seam, using track-mounted loaders like the one shown here.

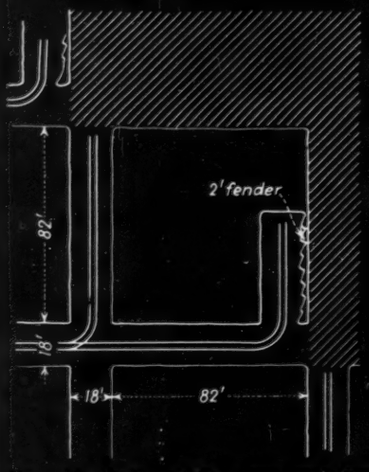


Fig. 13—Pillar mining by pocketing through from one side leaving a thin fender, Glen Cambria mine.

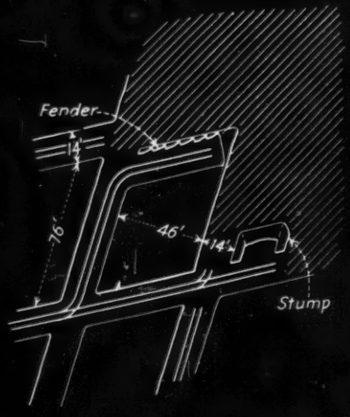


Fig. 14—Usual pillar-mining plan, Robinson Run No. 2 mine.

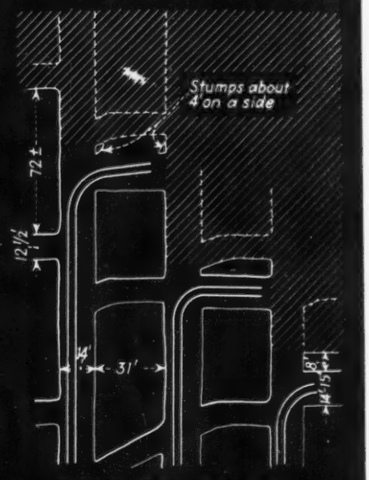


Fig. 15—Pillar-mining plan, Dawson No. 2 mine.

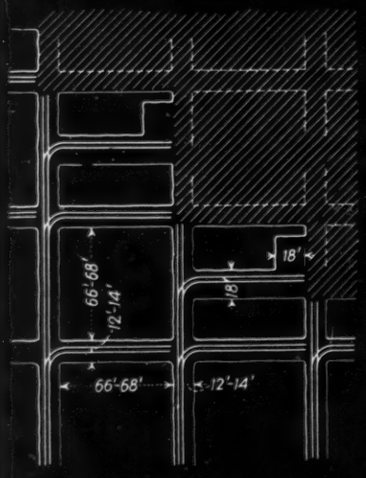


Fig. 16—Pillar-mining plan, Pursglove mines.

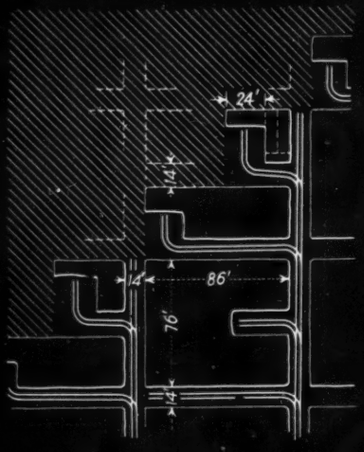


Fig. 17—Pillar-mining plan, Maiden mine.

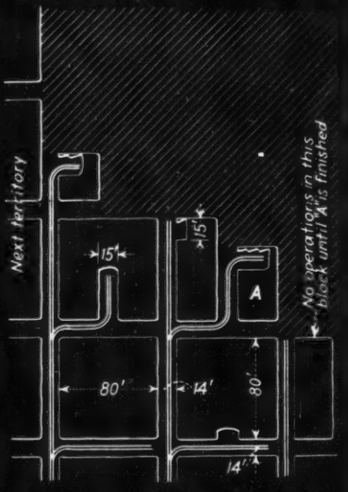


Fig. 18—Pillar-mining plan, Emily mine.

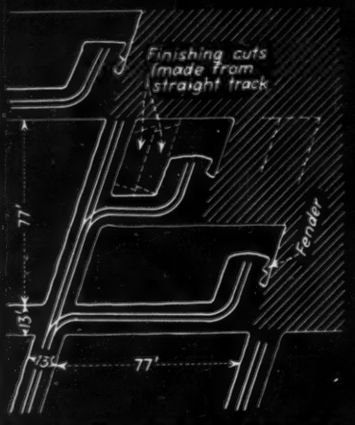


Fig. 19—Pillar-mining plan, Mona mine.

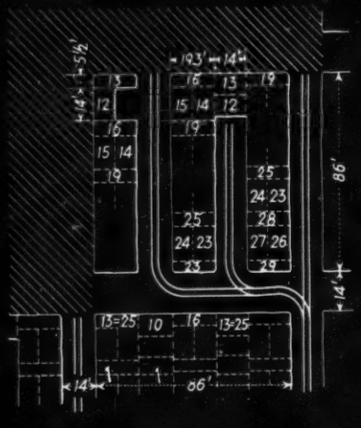


Fig. 20—Pillar-mining plan employing two splits used at Eagle and Rosemont mines.

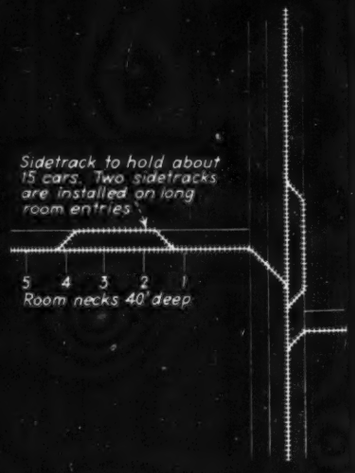


Fig. 21—Showing diagrammatically how sidetracks are installed in back headings at Louise mine.

which either are recovered or shot.

At Dawson No. 2 mine, using, as stated above, the room-and-pillar system, pillars normally are about 30 ft. wide and 72 ft. long. In pillaring, pockets about 15 ft. wide are driven through in succession (Fig. 15), leaving 8-ft. fenders, which are cut through to leave stumps at each end for final recovery. Track is carried on the left-hand rib to provide an easier curve into the pillar places to the right.

Users of the splitting plan generally rely on one split through the center of the block, although there are a few exceptions. At Pursglove Nos. 2 and 15 mines, for instance, where the blocks usually are 66 ft. square, an 18-ft. place is driven through the center as indicated in Fig. 16. Then places are driven across the ends of the two halves (open-ending) to work them out. A somewhat similar system (Fig. 17) is used at the Maiden mine, where block size is 76x86 ft. The finishing operation, however, is somewhat different from Pursglove, as a comparison of Figs. 16 and 17 will show.

Blocks Split at Emily

Blocks 80 ft. square are made at Emily mine and these are split through the middle by places about 15 ft. wide. This splitting is followed by pocketing through the two halves, leaving a thin fender against the gob, which is recovered or broken down in the usual manner. Operations in new blocks, as indicated in Fig. 18, normally are not started until half the preceding block is mined out. Except for certain differences in width of opening, an almost identical system is used in mining 86x86-ft. blocks at Federal No. 3.

Blocks are diamond-shaped at Mona mine but otherwise the recovery system is very similar to those at Emily and Federal No. 3. As indicated in Fig. 19, the block is split through the middle, whereupon pocketing is started in the two halves, leaving a thin fender after the second cut. The finishing operation in each half pillar is slabbing two cuts deep from the straight track, as shown in the sketch. Splitting and open-ending are kept in step in all pillars so that each is at the same stage of recovery at all times, thus maintaining a regular line.

Eagle mine, which formerly worked blocks 75 or 85 ft. square on the open-ending plan, has changed to a system of splitting, pocketing and slabbing. Now, three splits are driven through a pillar on a definite schedule of starting times. In other words, as indicated in Fig. 20, when No. 1 split is in to the fourth cut, the first cut is made in No. 2 split. And when Cut No. 25 is made in No. 1 pillar, No. 13 should be made in No. 2 pillar, etc. When a split is driven through, two cuts are made to put through the pocket in the pillar next to the gob, after which the stump is slabbed. The machine then drops back and starts another pocket. With 86-ft.-square blocks, the new system, among other things, provides 268 ft. of solid work in splitting through the pillar, plus other solid work in pocketing, and also keeps the machine from working next to gob the maximum part of the time. This latter was one of the major reasons for changing to the new system, which also is used at the Rosemont mine of the same interests.

Mechanized mines in northern West Virginia follow almost entirely the well-established practice of incorporating one of each type of equipment unit into a production unit. Thus, as a general rule, a unit will consist of loading machine itself, a cutting machine, a drill and one gathering locomotive. In certain cases the drill will be mounted on the cutting machine, as at Maiden mine, where production units are made up of a Joy 11BU loader, a Sullivan 7AU or Jeffrey 29-LE track-mounted cutter carrying a Sullivan or Jeffrey A-6 drill, and a 6- or 8-ton Westinghouse locomotive. Only one operation uses track-mounted drills: i.e., Mona, where a unit comprises a Jeffrey L-400 loader, 7AU cutter, Jeffrey 56-A single-spindle track drill and 6-ton Jeffrey locomotive.

With the exception of Maiden and Mona, mechanized mines in Monongalia have gone solidly to the hand-held drill, such as Bunker, using Cincinnati and Jeffrey A-7 equipment along with 7BU or 8BU loading machines, Jeffrey 35-B cutters and 6-ton rebuilt Ironton battery locomotives with G. E. cable reels. Louise units consist of an 8BU or 44-D loader, Goodman universal or standard shortwall, A-7 drill and a similar rebuilt Ironton locomotive. Pursglove Nos. 2 and 15 mines include in their productions units a 7BU loader, 35-B or 35-BB shortwall, Chicago Pneumatic or A-7 drill and 6-ton Jeffrey or General Electric locomotive. Another user of shortwall cutters alone is Continental No. 4, where units are made up of a 7BU or 44-D loader, 35-BB cutter, A-7 drill and a 6-ton Jeffrey locomotive. This is balanced in the other classification by Emily mine, where a unit comprises a No. 3 or 4 size Whaley "Automat" loader, plus a 7AU or Jeffrey 29-LE cutter, A-7 drill and 6-ton Goodman, 5-ton Goodman "doodlebug" or 5-ton Morgan-Gardner locomotive.

Several examples of the use of both track-mounted and shortwall equipment also are found in Monongalia, such as: Rosedale, 11BU loaders, 7AU or 35BB cutters, A-7 drills and 6-ton General Electric locomotives; Robinson Run No. 2, 10BU or 11BU loaders, Sullivan 7AU or 7-B "Super" shortwalls, A-7 drills and 8-ton Jeffrey locomotives; or Federal No. 3, 11BU loaders, 7AU or Goodman 112-CJ and EC cutters, Chicago Pneumatic drills, including a new 571-AP "Whippet" unit, and 6-ton Goodman flameproof locomotives.

South of Monongalia, post-mounted drills are in the great majority. Rachel mine uses both types (Chicago Pneumatic post and A-7 hand), along with Sullivan CE-7 shortwalls, 7BU loading machines and Ironton 6½-ton locomotives with Gould batteries. Eagle-mine units are made up of 10BU or 11BU loaders, 7-AU, Goodman standard or 35-B cutters, Chicago Pneumatic or Jeffrey A-6 post-mounted drills, in addition to one Sullivan drill on the 7AU machine, and Jeffrey or Westinghouse 6-ton locomotives. Dawson No. 2 accompanies its Goodman 260B loaders with one Jeffrey 29-U track-mounted or Goodman 12-EA shortwall cutter, an A-6 post drill and a Westinghouse 6-ton locomotive. At Glen Cambria, mechanical-loading units comprise an 11BU loader, 35-B shortwall, A-6 post drill and 6-ton Goodman or Jeffrey locomotive.

One Cutter With Loader

It will be noted from the above that one cutting machine, whether shortwall or track-mounted, normally accompanies one loading machine. Track-mounted cutting units, particularly the new type also designed for shearing, normally can cut more coal than a loader could handle, while most shortwall machines can keep up. However, where the latter type of equipment is used, some mines find it necessary to run extra cutting shifts. And at Jamison No. 8 mine, where Jeffrey 29-U track-mounted machines are used with 260B and 360B loaders, advantage has been taken of their higher capacity by having one unit cut and shear three shifts to supply coal for four loading-machine shifts. One machine has cut as high as 25 places 12 to 15 ft. wide in one shift. A Goodman universal serves the 8BU loader at this operation. Chicago Pneumatic post-mounted drills are used and coal is gathered by Jeffrey

or Westinghouse 6-ton locomotives. At Jamison No. 9, using three 260B and one 360B loading machines, cutting is done by two 29-U and one 29-C machines, drilling by CP post-mounted units and gathering by 6-ton Goodman and Jeffrey locomotives.

Unit crews at northern West Virginia mines using cars and locomotives for changing comprise ten to fifteen men as a rule, although at the Jamison mines fifteen is the standard on the second shift with one-locomotive changing, whereas on the first shift extra timbermen, tracklayers, etc., may bring the number up to nineteen. At the Pursglove mines, skeleton crews frequently are used, particularly on the late shift, where a shortage of mine cars may occur and thus limit production. And where necessary, two skeleton crews can be thrown together to make a full crew. Skeleton crews also fit very nicely, in the management's opinion, into one-, two- or three-place working sections. On the basis of reported average machine crews and tonnages at the time of the *Coal Age* study, output per crew man employed per shift ranged from about 15 to 27.5 tons, with all but a very few operations falling in the range of 15 to 22 or 23 tons.

When it comes to crew make-up, Monongalia County and the rest of the region part company on drilling. In Monongalia, with only one or two exceptions, the cutting crew also does the drilling. Thus, a crew normally is made up of a loader operator and helper (on all machines except 44-Ds, where an extra helper, or faceman, is employed), two cutters who also drill, one motorman and one snapper, one to three timbermen, one to two trackmen, one shotfirer and one boss. At Robinson Run No. 2, on the other hand, separate cutting and drilling crews are provided, and the same is true at practically all mines in the counties south of Monongalia. Thus, the basic crew members south of Monongalia County are: loader operator and helper, two cutters, two drillers, one or two motormen, one snapper, one or two timbermen, two tracklayers and one boss. In some cases, shotfirers are included; in others, the drillers do the shooting. Clean-up men are added at the Jamison and Dawson No. 2 mines, while Jamison commonly includes also a pipe-and-brattice man.

Few changes in the conventional operating cycle are found in northern West Virginia mechanical mines. Steps usually consist of extending timber and track, cutting or cutting and shearing, drilling (these operations may be transposed), bugdusting (normally only with bottom cutting), loading and shooting. To these might be added cleaning up, which generally is allocated to the loading and cutting crews, although, as noted, some mines employ hand loaders or clean-up men for this purpose.

Items entering in face preparation are the subject of a separate article beginning on p. 68 of this issue. Timbering is guided by regulations of the State Department of Mines, which call for two crossbars at the face at all times, as well as clearances of 30 and 12 in. Where top cutting is the practice, it usually is impossible to get the last bar much closer than 9 or 10 ft. to the face, so in many cases an additional bar or posts are set after cutting. With shortwall cutting, however, bars can be placed almost against the face before it is cut.

Behind the face, place width and clearance limitations in many mines leave the ribs as the only location for single posts. Consequently, at these operations, crossbars are almost compulsory for support away from the ribs. At Mona, as an example, one crossbar is set every cut, in addition to the safety bars at the face. But where added width is available, single posts may be of service. And posts commonly are used where track is laid on one side of the place. At Louise, as one example, two rows of posts on 6-ft. centers are set on the wide side, while at Dawson No. 2, one row on 4-ft. centers is the standard. Wood is the favored crossbar material, and bars generally are sawed on at least two sides to give faces 6 to 8 in. wide. Thickness ranges up to 6 or 8 in., but where the coal is thin it may be reduced to 3 or 4 in. to conserve working height over the loading machine.

Loading off a pillar into a shuttle car at Laura Lee mine. The timber visible in the picture is an indication of the top conditions frequently encountered. Just before this illustration was made about a foot of drawslate had come down on the cut and was broken up and loaded out.

Each Room Has Track

In view of the small number of working places usually constituting a machine territory and the general practice of opening new places only as fast as they are needed to keep a pillar line going, special track layouts for car-changing, storage, etc., are in the minority in northern West Virginia. Usually, a separate track is carried in each room and a switch is laid in each crosscut or other opening. Thus, a changing point normally is available in each place at the first crosscut back, which, under the block system generally employed, seldom is over 100 ft. from the face.

Empty and loaded trips normally are stored on the headings or in adjacent places, although some gathering locomotives work from sidetracks at all times. The sidetrack, however, usually is the basing point for the main-line or relay locomotive, rather than the gathering locomotive. In many cases, such sidetracks are placed in back headings on main, cross or room entries, although some operators drive special sidetrack openings at the mouths of the butt entries. Louise mine, on the other hand, is one of a group of operations placing sidetracks in back headings. Usual Louise practice is shown diagrammatically in Fig. 21. "Picking up" places seldom is practiced in the region. One of the exceptions is Bunker mine, which uses a pick-up

plan when driving a group of new places to keep a pillar line going. In the Bunker system (Fig. 1), one place on each side of the center is picked up through the first crosscut.

Gathering locomotives usually take 3 to 5 cars to the loader, kicking the loads one after another into the nearest place where a switch and enough track are available. Several mines leave the last car at the loader while going for a new trip of empties. Changing locomotives generally weigh 6 tons, with exceptions both above and below, as outlined above. Cable-reel equipment is used at all mines except Rachel, where the 6½-ton battery units (Gould batteries) also follow the usual practice of taking five to six cars to the loader, changing at the nearest switch, etc., and produce, on a normal working shift, around 80 to 90 cars holding from 2.5 to 2.7 tons, exclusive of service to pit-car loaders on stumps and the like.

A 6-ton buggy getting its load at Pinnikinnick No. 25 mine.

Change With One Motor

Two-locomotive changing, for the reasons outlined above, has been adopted in only rare instances. Jamison No. 9 mine, at the time of the *Coal Age* survey, offered the principal example of such operation. Here, two 6-ton cable-reel units regularly followed the 360B loader in use. It should be noted, however, that only one locomotive at a time actually does changing. Meanwhile, the other is taking its loads to the sidetrack and getting empties. Thus, the major saving lies in eliminating the loader wait incurred in trips to the sidetrack, which was sufficient to raise the tonnage per machine-shift to 350 average and over 400 on many occasions, as compared with an average of 250 for single-locomotive changing.

The natural limitations on possible production by mine-car changing, which are enhanced in pillar mining, particularly as practiced in northern West Virginia, have been the major factor in the adoption of rubber-tired haulage set-ups in the region. At the time of the *Coal Age* survey, rubber-tired equipment was in use at four mines, namely: Katherine, Katherine Coal Mining Co.; Laura Lee, Hutchinson Coal Co.; and Pinnikinnick No. 25, Consolidation Coal Co., all in Harrison County, plus Rachel mine in Marion County. An installation was scheduled for November at Federal No. 1 mine. At Laura Lee and No. 25, the entire output was derived from Joy loading machines served by two or three Joy shuttle cars, the only type of rubber-tired equipment then used in northern West Virginia.

The Joy shuttle car essentially is a rubber-tired four-wheeled battery-powered car with a conveyor in the bottom for discharging the contents into—usually—an elevating conveyor for transfer to mine cars. The boot of this conveyor may be sunk in a shallow pit or it may be set on the bottom with a timber ramp as an approach. Where necessary, a pothole is shot out in the trip-loading heading to permit the discharge end of the elevator to clear the cars sufficiently for maximum topping. In local parlance, the trip-loading installation, including elevator, ramp, etc., is known as a "tipple." Jacks on the elevating conveyor permit adjusting the height of discharge and wheels permit it being towed from place to place. Normally, tipples are moved to new locations when the haul exceeds 500 ft. or so. Caterpillar-mounted cutting machines are employed in connection with shuttle-car operation.

Rubber-tired haulage units, particularly in northern West Virginia, make their mark principally because they materially shorten the time a loading machine must wait between cars. A multiple number of changing units makes it possible to have one waiting at the mouth of the working opening ready to back in under the loader as soon as the other passes, as shown diagrammatically in Fig. 22. With a locomotive, on the other hand, it is necessary for the trip to come out, switch up the straight or into another place and then back up and switch into the working place again. Operators who have adopted shuttle cars also like the fact that track and track materials in working places are unnecessary. Dry working places, or a bottom that will not disintegrate when wet, while not absolutely necessary, are a help in shuttle-car mining, however.

First to adopt shuttle cars, or "buggies," was Katherine, which started mechanization of the Pittsburgh seam early in 1938 using Joy loaders and a combination of mine-car and shuttle servicing. In view of shuttle performance it has been accepted as standard, although mine cars and locomotives have not yet been displaced entirely. Consequently, when the *Coal Age* study was made, four 7BU loading machines were being served by locomotives while three 11BU units were accompanied by two or three 5-ton shuttle cars powered by Exide-Ironclad storage batteries, and a Jeffrey 29-C top cutter mounted on caterpillars. One unit also included a Sullivan CD-16 rubber-tired coal drill. Additional shuttle cars for a fourth unit were on order.

Coal thickness is about 7½ ft., of which about 8 in. is left in the top to hold the drawslate. The bottom is fireclay, which tends to disintegrate when wet, with the result that some corduroying has been necessary to facilitate shuttle-car operation in places. The coal is cut up into 76-ft.-square blocks by places driven 14 ft. wide. Blocks 36 ft. square were tried, but difficulties in their recovery led to a return to the 76-ft. blocks. These blocks, as shown in Fig. 23, are mined by pocketing through them from two sides, leaving a thin fender, and then splitting the remaining stump. Trips of 25 cars are brought to the elevating conveyor by a trolley locomotive, which moves them down

Shuttle-car dumping into elevating conveyor, Pinnikinnick No. 25.

one by one for loading, leaving the last two while a trip is made to the sidetrack for a new supply. Car capacity is 2½ tons, and an average of 190 to 200 cars per shift was being obtained from the shuttle-car sections in September, 1939, as compared with 80 to 100 cars from other loading machines served by locomotives. The shuttle-car record to date is 260 mine cars. Three cutting shifts were run for two loading shifts, and on this basis the usual daily crew was made up as follows: two loader operators, two helpers, six cutters, six drillers, four shuttle-car drivers, four timbermen, two car trimmers, two electricians and two bosses.

Mechanical mining started at the Laura Lee mine in January, 1939, at which time a unit consisting of 11BU loader, two 5-ton Joy shuttle cars powered by Exide-Ironclad batteries, a Chicago Pneumatic hand drill with a post drill as a spare, a rebuilt Goodman 148-B turret-type slabbing machine mounted on caterpillars for top cutting, a 6-ton General Electric cable-reel locomotive and a Joy elevating conveyor went into service in a finger of Pittsburgh coal under light cover. Total seam thickness is 7 to 7½ ft., of which about 1 ft. is left in the top. Over the coal is 8 to 10 ft. of rotten drawslate, while under it is soft fireclay. No water is present.

The top in the section is very bad and consequently materially reduces the output, due to its penchant for falling on top of the coal after it is cut or shot. Consequently, for every ten mine cars of coal produced it is necessary to load a minimum of 1 to 1½ cars of slate and rock and at times as high as three to four cars of refuse must be handled for every ten cars of coal. All this rock and other refuse must be picked up by the loading machine, hauled out in the shuttle cars, dumped over the elevating conveyor, and transported outside in mine cars for disposal. It may be seen, therefore, that rock-handling materially reduces effective productive time, but in spite of this handicap the average output per day of two loading shifts was 600 tons in the first seven months of 1939, running up to 650 tons in June and July. For this production, an average of 45 men were employed underground per day, with 32 men in the working section, or two unit crews comprising the following: motorman, brakeman, loader operator, loader helper, two buggy drivers, one scrapper, two cutters, two drillers, one shotfirer, two timbermen, one electrician and one boss.

A plan of the Laura Lee shuttle-car section is reproduced in Fig. 24, showing trackage, tipple locations, etc. Mining up to the time of the *Coal Age* survey was based on driving openings 12 ft. wide on 90-ft. centers and then recovering the resultant blocks by pocketing through from two sides, leaving thin fenders against the gob. When the top was unusually bad, however, it frequently was necessary to cut the width down as low as 9 ft., which made it somewhat difficult for the shuttle cars to turn corners. In future work, as indicated by the projections in Fig. 24, it is planned to reduce the centers to get an oblong block. In this way it is felt that it will not be necessary to open up a territory that, while necessary to provide the required tonnage in going up, will be much larger than needed when taking pillars, the latter meaning that nearly twice as many places would be available, counting a maximum of two per block, in the same territory. From another standpoint, shorter centers means that the same number of solid places would be contained in a smaller area, reducing the haul to the tipple. While hauls up to 900 ft. have been managed, the management is of the opinion that 400 to 500 ft. one way is the economical limit.

Trips of ten cars each (2 tons per car) are headed in past the tipple by the 6-ton locomotive, which then pulls back one car length at a time until loading is completed, whereupon it returns to the service sidetrack for a new trip. In addition to the service sidetrack, another siding is provided on the main line for storage, etc. Trips to the outside usually run 40 cars.

Shuttle Cars Studied

Pinnikinnick No. 25 mine of the Consolidation Coal Co., at the time of the *Coal Age* study, had been converted into a laboratory for the study of mechanical loading with shuttle-car servicing, this study not only including how to handle water and power but also such items as the effect of line brattices and sprinkler lines in working places on maneuvering with buggies, cutters, loaders, etc. Production equipment went in toward the end of March, 1939, and comprised a Joy 11BU loader, three 6-ton Joy shuttle cars (with Phileo permissible batteries on the sides instead of at the end, as at Katherine and Laura Lee, thus saving space next to the loader and reducing the possibility of damage), a Jeffery 29-LE cutting-and-shearing machine mounted on caterpillars, a Jeffrey A-6 post drill, Joy elevating conveyor and "Brownie" car puller, in addition to the usual battery-handling and charging equipment necessary with such installations. Facilities also included first-aid stations, pumps, emergency rock-dust reserves, drill and supply trucks, etc.

About 7 ft. of the 8-ft. Pittsburgh seam is taken at No. 25, where the bottom is a hard fireclay not affected by water—a rather fortunate eventuality in view of the fact that the territory chosen for the installation, near an outcrop, turned out to be rather flat, with the result that water stands in pools at all times. As development proceeds, however, it is expected that a grade sufficient to carry the water to the drainway provided (see Fig. 25) will be encoun-

tered. Meantime, pumps spotted at strategic locations move the inflow to the drainway. The head coal left holds the usual drawslate in good shape as a rule, although the company follows the practice of keeping three crossbars (4x4 steel H-beams) on Simplex jacks at the face, with other timber as necessary.

The block system is used at No. 25, with places driven 14 ft. wide on 90-ft. centers. As indicated in Fig. 25, the shuttle-car section was opened by two headings near the center. Curved connections are made between these headings every fourth crosscut for tipple set-ups. However, the second tipple location was not used on the advance. From these set-ups one side of the territory is being worked out, whereupon operations will be transferred to the opposite side to complete the job. In retreating, certain tipple locations will be brought into service for the second time.

Mine cars are brought in in trips of 35 and are headed in through the Y shown in Fig. 25, this to insure the end gates being in the right position when they start out, inasmuch as the cars are turned around in passing the elevating conveyor. From the Y, trips are moved up to the curved crossover, where they are hooked onto the car puller, remotely controlled from the tipple location.

Cut Three Shifts

Two-shift loading and three-shift cutting are the practice at No. 25. The latter is necessary because of the fact that places are sheared as well as cut and also because the cutter is rather slow-moving in traveling from place to place. Aside from cutters, the usual crew on one shift is made up of the following: loader operator and helper, two drillers, three timbermen, one shotfirer, one wireman, two or three shuttle-car drivers, one mechanic and batteryman and one car trimmer and trip controller, in addition to a boss. The total for two loading shifts therefore is 28 or 30 man-shifts, to which must be added six cutting man-shifts and four man-shifts worked by a floating crew on track, ditching, supplies, etc. In June, total man-shifts per day underground was 46 for an average output of 880 tons.

Two 6-ton shuttle cars with Gould batteries, plus an elevating conveyor, etc., went in behind a 7BU loader at Rachel mine Sept. 18. The immediate task of the unit is to advance a new main entry (seven headings 12 ft. wide on 40-ft. centers) into a new section of coal.

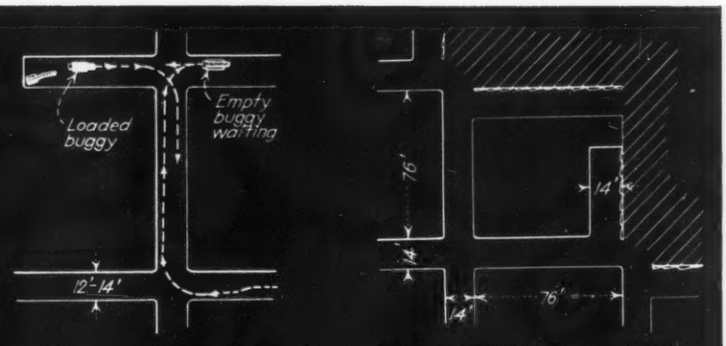


Fig. 22—Showing diagrammatically how loading time is reduced by using two or more rubber-tired haulage units.

Fig. 23—Pillar-mining plan, Katherine mine.

Fig. 24—Shuttle-car section, Laura Lee mine, showing projections for future tipples and places on short centers.

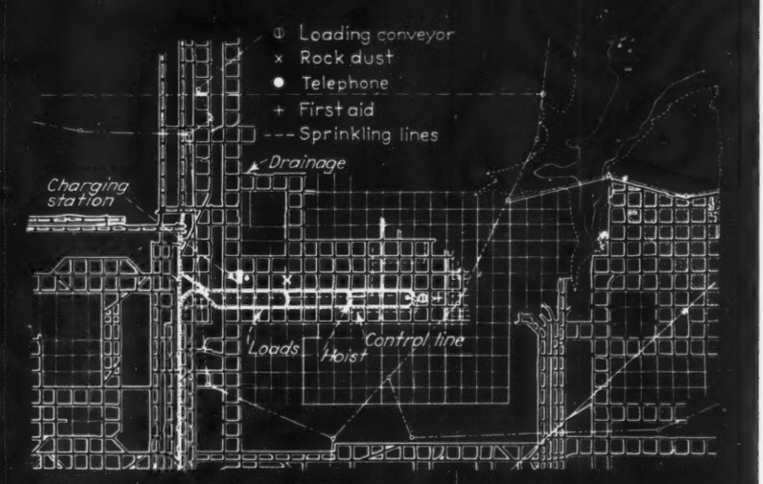


Fig. 25—Shuttle-car section, Pinnikinnick No. 25 mine, showing disposition of equipment units.

FACE PREPARATION

+ At Northern West Virginia Mechanical Mines

DEEP CUTTING and widespread use of track-mounted machines are some of the major features of face-preparation practices at mechanized mines in the Fairmont field of northern West Virginia. As most of the track-mounted units were installed after the advent of loading machines and naturally are of the latest universal type, shearing normally supplements bottom or top cutting and some mines have resorted to top cutting and shearing on two sides on main haulways with a long life. Standard bits in a few instances with hard surfacing, are used at most operations, but the use of patent chains and bits is growing. One machine was equipped with a thin-kerf bar at the time of the *Coal Age* survey, while three mines using rubber-tired haulage equipment had cutting equipment mounted on caterpillars.

Hand-held drills are used in more than half the mechanical-loading mines, with most of the rest employing the post-mounted type. Exceptions include track-mounted drilling units at one property and a rubber-tired drill at another. Permissible explosives, normally tamped solid, are the usual coal-breaking medium, although some mines have gone to carbon-dioxide in steel shells. Snubbing holes are employed in a number of instances with bottom cutting, either to break down bands or to facilitate rolling out the top and back portion of the cut with less powder.

Natural conditions, as might be expected, have had a substantial bearing on face-preparation practices. In the Pittsburgh coal, in particular, drawslate or other weak strata over the seam make it necessary to reduce place width, resulting in a trend to deeper cutting to increase the coal available per loading-machine move. Bad top also is responsible for the almost-universal practice of leaving "head coal" in Pittsburgh-coal mines, although another reason is that this coal normally is lower in quality. As a rule, a definite parting, or group or partings, separates the head coal from the main seam and, where bottom cutting is the practice, drilling and shooting must be conducted to affect this head coal and the overlying top as little as possible. To make assurance doubly sure, however, many mines have gone to top cutting. On the other hand, however, a low-grade streak in the lower part of the seam plus the possibility of the loading machine getting into the bottom has caused some operators, after weighing all factors, to continue bottom cutting.

Coal in northern West Virginia also is distinguished by pronounced face and butt cleats, with the result that mining plans normally are laid out to get as much work as possible on the face, thus increasing coarse-coal output with less powder. Quite frequently, butt work requires as much as 20 to 25 per cent more explosive than face work. Also, coal is more difficult to shoot on the butts, with the result that the loadability of the fall often is decreased, with consequent loss of time and increased wear and tear on equipment.

Bottom cutting with shortwall machines is the practice at the four mechanized mines in the Sewickley seam in the Scotts Run region of Monongalia County visited by *Coal Age*. In these mines, the roof normally is fairly good in character and all the coal is taken, including, at some, the bottoms left by the cutting machine. An exception is Continental No. 4 mine, Continental Coal Co., where rash under the coal (5½ ft. thick) has resulted in leaving the bottom down. Three holes normally are drilled in a place in this mine regardless of width, which may range from 12 to 18 ft., depending

Ready for the loading machine—a powder-shot Sewickley seam-face in Bunker mine.

One of the many hand-held drills in Monongalia County at work in Bunker mine.

Putting a rib hole in a center-sheared place in Pittsburgh coal, Rosedale mine.

upon the type (headings, rooms or pillars). In the average place, usually around 14 ft. wide, about seven sticks of 1½x8-in. Lump Coal C are used with Western "Protect-O-Seal" electric detonators. Usual number of sticks per hole is given in Fig. 1. Cutting is done with Jeffrey 35-BB shortwalls with 7½-ft. standard-kerf bars. One Prox "ToolSteeL" chain and bits were being used at the time of the *Coal Age* survey, with Prox standard chains on the other machines. Drilling is done with Jeffrey A-7 hand-held units fitted with McLaughlin conveyor-type augers, cutting heads and bits.

A band some 2 to 2½ ft. down from the top at the Bunker mine of the Davis-Wilson Coal Co. (Sewickley seam, 5 to 5½ ft. thick) has resulted in the use of a center breaker shot drilled straight in as shown in Fig. 2. Cutting is done by 35-B shortwalls with 8-ft. standard-kerf bars with standard hand-forged bits, and drilling by Cincinnati or A-7 equipment using McLaughlin twisted or conveyor-type augers. The twisted auger, in the management's experience, cleans the hole better in wet sections. Place width ranges from 14 to 18 ft. and the usual number of holes required is three or four. In face places, it often is possible to break down the coal with three holes, or one on each rib in addition to the breaker hole. In butt places, an extra hole often is drilled just slightly off center, as shown in Fig. 2. The coal is shot with 1½x6-in. Lump Coal C and General electric detonators. In accordance with usual practice in the region, charges are tamped solid with rock dust to the mouth of the hole.

A substantially similar shooting plan is employed at the Louise mine of the Louise Coal Co., also recovering the Sewickley coal, which averages about 5 ft. and includes a band in some places about 28 in. above the floor. Cutting is done by Goodman standard and universal shortwalls using standard-kerf bars and Warwood bits, drilling by A-7 units with McLaughlin twisted and conveyor-type augers. Louise also uses 1½x6-in. Lump Coal C—the only other operation besides Bunker in the mechanized group to adopt this size of explosive. Where the band is present, a short hole (4 to 5 ft. deep) is drilled directly over it. The position of this hole is controlled by the position of the track, as indicated in Fig. 3. A second hole is drilled a short distance above the band, if present, with two others in the top on each rib. Even if the band is absent, the short snubber has been found advantageous in permitting the loading machines, particularly the 44-D unit, to get into the cut. Rock dust is employed as stemming and in rib holes an air space about 10 in. long is left in front of the charge in certain sections for a cushion effect, primarily to cut down the production of slack from shooting against a solid rib.

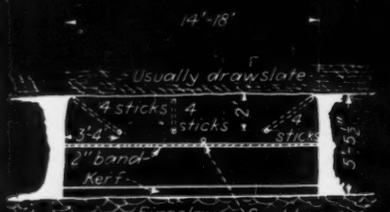
A snubbing hole normally is drilled under the band at the Pursglove No. 2 mine of the Pursglove Coal Mining Co., where Sewickley thickness ranges from 4 to 5½ ft. Cutting is done by 35-B and BB machines with 7½- and 8½-ft. bars, one equipped with a Bowdil chain and bits. Chicago Pneumatic and A-7 hand-held drills with McLaughlin augers, heads and bits are used. Place width ranges from 12 to 14 to 18 ft. In addition to the snubbing hole, angled down about 6 in. and about 1 ft. short, a place normally is shot with three top holes loaded with 1½x8-in. Hercules Red H F and fired with Atlas "Manasite" electric detonators. One stick of powder usually produces a car of coal, about 2½ tons.

The same type of cutting and drilling equipment, as well as the same type of explosive, is used at the Pursglove No. 15 mine, but here, except for the fact that openings are the same in width, the similarity in face preparation ends. As No. 15 is in the Pittsburgh seam, head coal is left. The line of demarcation between the head coal and the rest of the seam is the "6-Ft. Binder," so called because it occurs at about that height (6½ ft. at No. 15) above the bottom. Two additional thin partings separated about 6 in. usually are found about 4 ft. above the bottom. The snubbing hole in solid work, as shown in Fig. 5, is drilled under this double parting about 2 ft. off center. This hole is shot first and the coal is loaded, after which the three top holes are fired, starting with the center. Loading out the snub coal provides more room for the top bench so that it falls in a looser and more loadable condition. In addition, there is a tendency to reduce slack output.

The usual powder charge in 12- to 14-ft.-wide places in solid work is given in Fig. 5; 18-ft.-wide solid places sometimes, but not always, require slightly more explosive. The number of sticks used, however, is subject to considerable variation, depending upon whether the place is driving on the face or butts, occurrence of sulphur balls, etc. Places 18 ft. wide also are driven in recovering pillars by the open-ending method, and in these places the snubber is moved over to the solid rib (Fig. 5). Normally, because of the open end in addition to the undercut, a pillar place can be shot with less powder, although here also the quantity will vary. No. 15 mine now is experimenting with the use

About 24-25 tons when cut 14' wide and 6½' to 7' deep; about 7 sticks 1½ x 8 powder

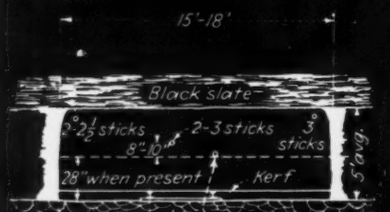
Fig. 1—Drilling plan, Continental No. 4 mine.



Some places shot with only three holes, eliminating middle one in top row

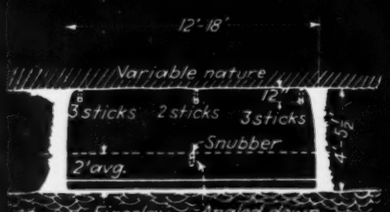
About 20-22 tons cut 14' wide and 7'-7½' deep; about 15 sticks 1½ x 6 powder with four holes

Fig. 2—Drilling plan employing snub shot, Bunker mine.



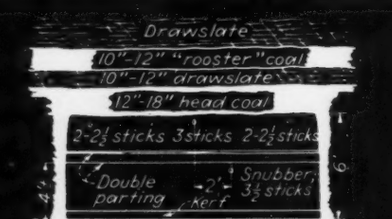
About 20-25 ton when cut 7'-7½' deep; about 8-10 sticks 1½ x 6 powder

Fig. 3—Drilling plan with short snub hole, Louise mine.



Cut about 6½'-7' or 7½'-8' deep. Average yield, about 2½ tons per stick 1½ x 8 powder

Fig. 4—Drilling plan, solid work, with center snubber, Pursglove No. 2 mine.



About 22 tons when cut 14' wide and 6½' deep; about 10½-11½ sticks 1½ x 8 powder normally but number may vary considerably with face and butt places, sulphur occurrence, etc.

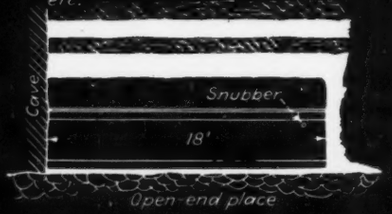
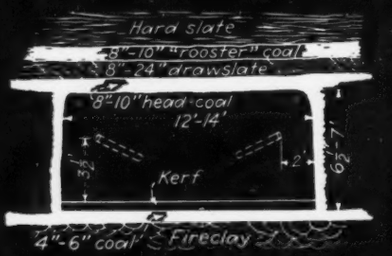
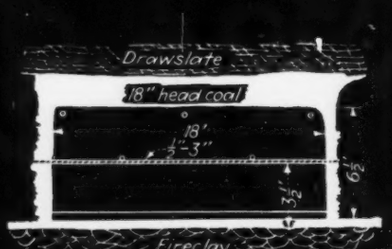


Fig. 5—Above, drilling plan for places in solid work, powder shooting, Pursglove No. 15 mine, showing use of snubbing hole near center. In an 18-ft.-wide open-end place (lower view), the snubber is moved over to the solid rib.



About 25 tons when cut 14' wide and 6½' deep; powder is used in the top holes and CO_2 in the two holes in the bottom bench for better lump and increased loadability

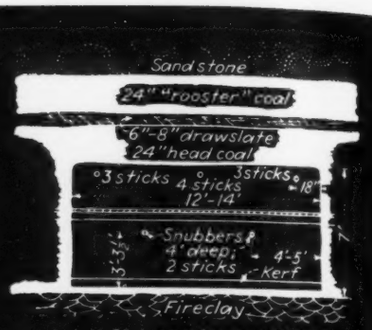
Fig. 6—"Split-shooting" plan at Rachel mine.



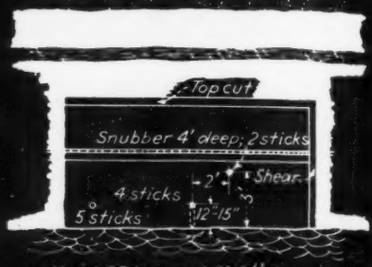
About 20-25 tons when cut 6' deep; about 16-17 sticks powder

Four holes only are drilled in 13' heading making about 15 tons with 12-13 sticks

Fig. 7—Drilling plan for 18-ft.-wide place, Glen Cambria mine.



About 20 tons when cut 7' deep; about 14 sticks 1¼ x 8 powder



About 25 tons cut 8'-8½' deep; about 11 sticks 1½ x 8 powder

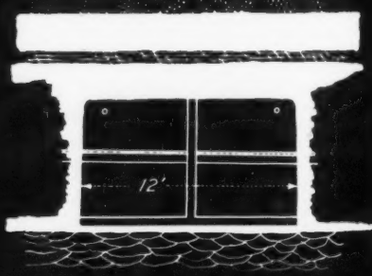
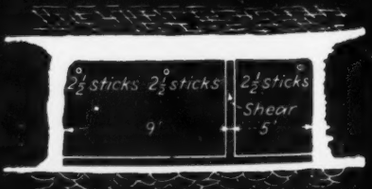


Fig. 8—Commonly used drilling plans at Rosedale mine.

About 25 tons when cut 8' deep; about 8-9 sticks 1½ x 8 powder



About 25 tons when cut 8' deep; about 7 sticks 1½ x 8 powder in face place; 8 sticks in butt place

Fig. 9—Drilling plans for narrow places both bottom cut and botton cut and sheared, Federal No. 3 mine.

of two snubbing holes loaded with Cardox to bring down the bottom coal, with three powder holes in the top to break down that portion of the seam.

Aside from Pursglove No. 15, two other mines in the Pittsburgh seam were found to be bottom-cutting only in the *Coal Age* study. At the Rachel mine, Jones Collieries, Inc., in Marion County, cutting is done by Sullivan CE-7 shortwalls with 7½-ft. bars. All machines at Rachel are equipped with Cincinnati "Duplex" chains and bits, which, in addition to reduced maintenance resulting from easier cutting, lower power consumption, etc., have reduced bit cost 30 per cent. Drilling is done with Chicago Pneumatic and Jeffrey A-6 post drills, using Cardox augers and cutting heads. A double parting normally is found about 4½ to 5 ft. above the bottom at Rachel, where 6½ to 7 ft. of Pittsburgh coal is taken, and, when using powder, two holes normally were drilled about 12 in. under it to break down the bottom bench. The remainder of the cut then was brought down with three top holes. Headings and rooms vary from 12 to 14 ft. in width; pillar places, 14 to 16 ft.

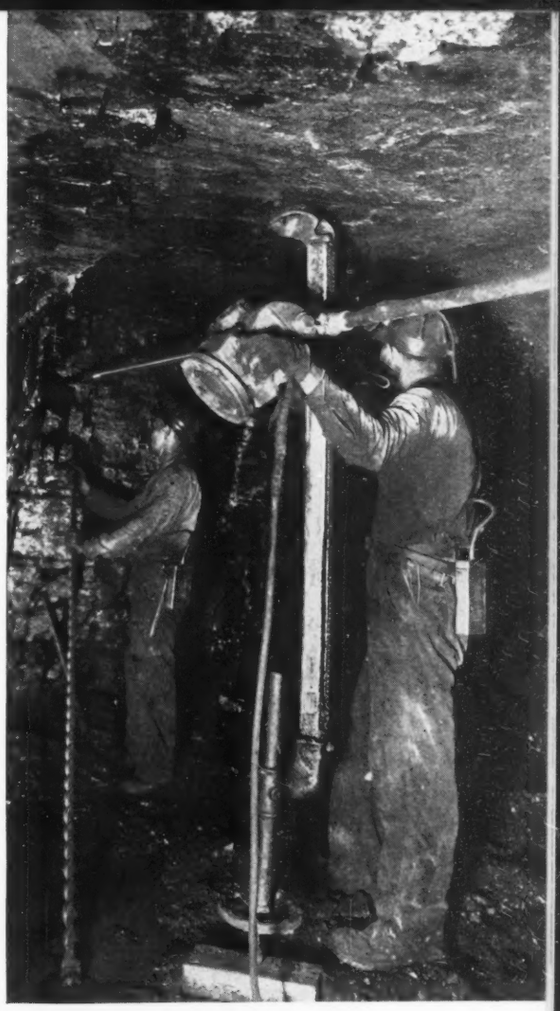
Since September, however, Rachel has installed a Cardox charging plant and is using a system of "split shooting." In other words, the lower bench is broken down with low-pressure large-volume Cardox shells for increased coarse-coal yield and loadability. Two holes are drilled for this purpose about as indicated in Fig. 6. With the bottom bench down, the top coal is shot lightly (three holes) with a slow permissible powder to eliminate the possibility of gas working over the roof, inasmuch as no natural baffle has been found. Approximately 60 to 70 per cent of the coal, it has been found, is kicked out by the Cardox.

Cutting at the Glen Cambria mine of the Mountain Fuel Co., in Barbour County, where entries in the Pittsburgh seam, of which about 6½ ft. is taken, are 13 ft. wide and rooms and pillar places 18 ft. wide, is done with 35-B machines with 6½ and 8½-ft. bars. A-6 post drills are used. Five holes usually are drilled in a place 18 ft. wide and are positioned about as in Fig. 7, with two just above a parting about 3½ ft. above the bottom. In a 13-ft. place, only one breaker hole—near the center—normally is drilled. Shooting is done with Genite 4 permissible.

Some seven mines included in the *Coal Age* survey employ a combination of shortwall or other bottom-cutting machines along with cutting-and-shearing machines. The Rosedale mine of the Rosedale Coal Co., in Monongalia County, as an example, uses Sullivan 7-AU cutting-and-shearing and Goodman 112-AB shortwall units, in addition to 12-AB and 35-BB equipment held in reserve. About 7 ft. of Pittsburgh coal is taken. Heading width is 12 ft.; rooms, 14 ft.; open-end pillar places, 12 ft. A variety of cutting and drilling plans are used, depending upon the conditions encountered, and drilling is done with A-7 equipment, using McLaughlin twisted augers.

A common drilling plan with shortwall machines at Rosedale is based on five holes, three in the top and two short snubbers 4 ft. deep just under a double parting about 3½ to 4 ft. above the bottom (Fig. 8). With the track-mounted equipment, right-side shearing is the usual practice, particularly in 14-ft. places. In this case (Fig. 8), two holes are drilled at the bottom on the side opposite the shear, one straight in and the other angling down to hit the rock and break the coal loose. A third hole, only 4 ft. deep, is drilled below the partings and on the side next to the shear. This hole acts as a breaker, or reliever, for the other two shots. Where center shearing is done, usually in 12-ft. headings, places may be either top or bottom cut. In either case, one hole in each top or bottom corner is the rule (Fig. 8). In general, the practice is to top cut only where the roof is bad; otherwise the cut is made on the bottom so that coal can be left down to prevent the loading machines from digging into the fireclay. On 7-AU sections, the coal usually is shot with 1½x8-in. Burton A; shortwall sections, 1¼x8-in. Genite F. General electric detonators are used.

Cutting equipment at Robinson Run No. 2 mine, Christopher Mining Co., Monongalia County, where about 6½ ft. of Pittsburgh coal is taken and places are driven 12 to 14 ft. wide, comprises both Sullivan 7-AU universal and 7-B "Super" short-



Drilling with post-mounted equipment and twisted augers, Jamison No. 8 mine.

Track-mounted machine making a shear cut in a pillar place, Dawson No. 2 mine.

walls, all with 8-ft. bars and standard-thickness-kerf chains using Warwood bits. Drills are A-7 units fitted with McLaughlin twisted augers, heads and bits. Shooting is done with 1½x8-in. Lump Coal C with General electric detonators.

Three holes are drilled in shortwall places at Robinson Run, two in the top and one 4-ft.-deep snubber beneath a band about 4 ft. above the bottom (Fig. 10). It is loaded lightly to knock down the front of the cut, after which the breaker shot—one of the top holes—and the remaining rib shot are fired. With the 7-AU equipment, places usually are center-sheared and shot with two top holes placed about as in Fig. 10. In headings designed for permanent haulways, where the best possible top and rib conditions are desired, places are top cut and sheared on both sides, and are shot with two holes in the bottom drilled to the rock at the back of the cut.

Federal No. 3 mine of the Koppers Coal Co., in Monongalia County, uses both 7-AU and Goodman 112-CJ and EC cutting equipment. The 7-AU unit makes a thin (4½-in.) kerf. All machines are equipped with 9-ft. bars, and both No. 3 and Federal No. 1 mine, in Marion County, use Haystellite-treated bits. Treating was adopted in the fall of 1938, and no grinding of bits is done either before or after application of the hard-surfacing, which was one factor considered in the selection of the material. Bit consumption has been cut about one-third, in addition to other advantages, including a reduction in cost of power from 48c. to 46.5c. per 1,000 sq.ft., and $2.39 to $2.12 per 1,000 tons cut. Drilling at No. 3 is done with Chicago Pneumatic hand-held equipment, including a new 571-AP "Whippet" clutch-equipped unit. Hardsocg twisted augers with welded-on McLaughlin heads are employed. Shooting is done with 1½x8-in. Liberty No. 9.

About 5½ to 6 ft. of Pittsburgh coal is mined at Federal No. 3, where headings and rooms are 14 ft. wide and pillar places 18 to 25 ft. A bottom-cut place 14 ft. wide normally is shot with three holes (Fig. 9), including one about 5 to 6 ft. deep between two partings about 40 in. above the undercut. Two additional holes are put in the top, with occasionally another hole when there is a hump on the face. Where shearing is done, the shear is made about 5 ft. from one rib, with two holes in the top on one side and one in the top on the other (Fig. 9). Top cutting also is done on occasion, and in that case the holes are transferred to the bottom.

Bits Hard-Surfaced

Hard-surfacing of cutter-bit tips also is the practice at the Jamison Nos. 8 and 9 mines of the Jamison Coal & Coke Co., in Marion County, where the use of "Stoodite" has resulted in a substantial increase in output per point, as well as easier machine operation and decreased power. Cutting equipment at No. 8 comprises Jeffrey 29-U track-mounted universal machines with 9-ft. standard-kerf bars and a Goodman universal shortwall with 7-ft. bar. Four 29-U shifts commonly are worked to supply coal for six loading-machine shifts. Chicago Pneumatic post drills are used at No. 8, together with Hardsocg twisted augers, cutter heads and bits. Twisted augers, experience at this mine has shown, drill more coal with fewer bits, and in fact one set of bits will drill sixteen or seventeen places.

At No. 9 mine, 29-U universal and 29-C bottom cutters with 9-ft. bars are in service, along with CP post drills with Hardsocg and Cardox augers. Coal at both mines is shot with 1⅜x8-in. Genite E and General electric detonators. Present cutting equipment went into service early in 1939, when the previous air-driven equipment used for thirteen years (August, 1930, *Coal Age*, p. 475) was discarded as not suitable for incorporation into a mechanical-loading set-up. One result was a substantial decrease in power for cutting. A corollary has been a substantial improvement in ventilation at the face, inasmuch as standards necessarily had to be revised to take care of the possibility of accidental arcing in the working place in spite of the fact that permissible or flameproof equipment is used.

About 7 ft. of Pittsburgh coal is taken at the Jamison mines, where

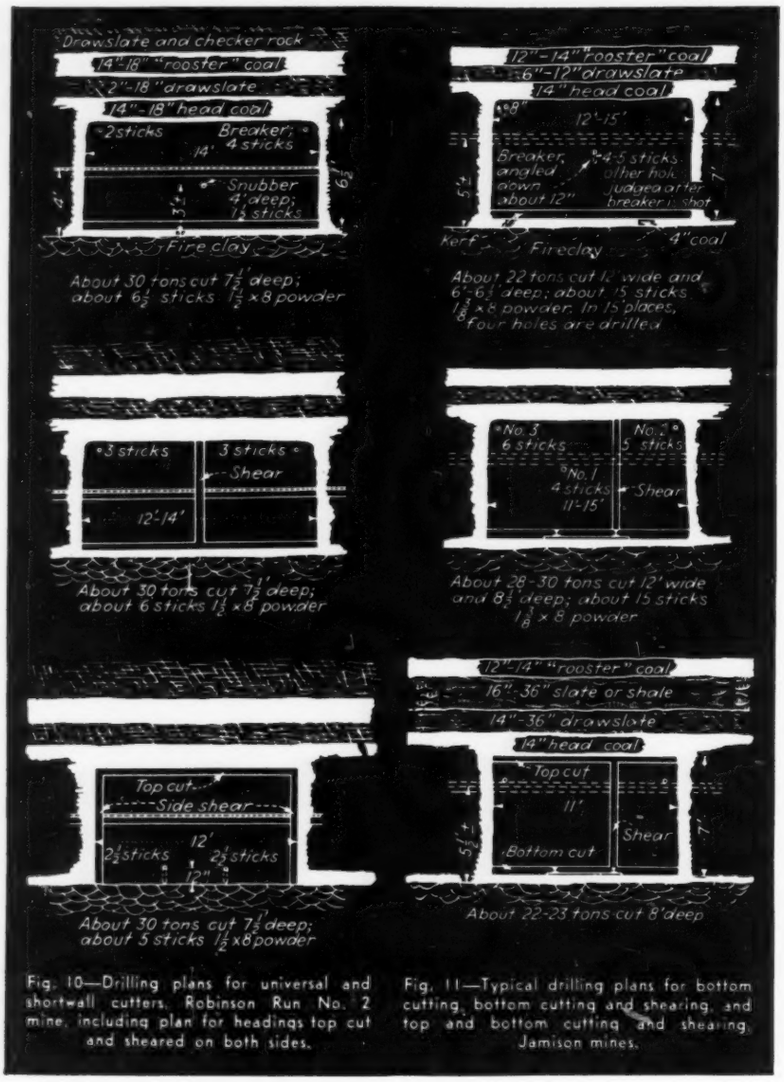
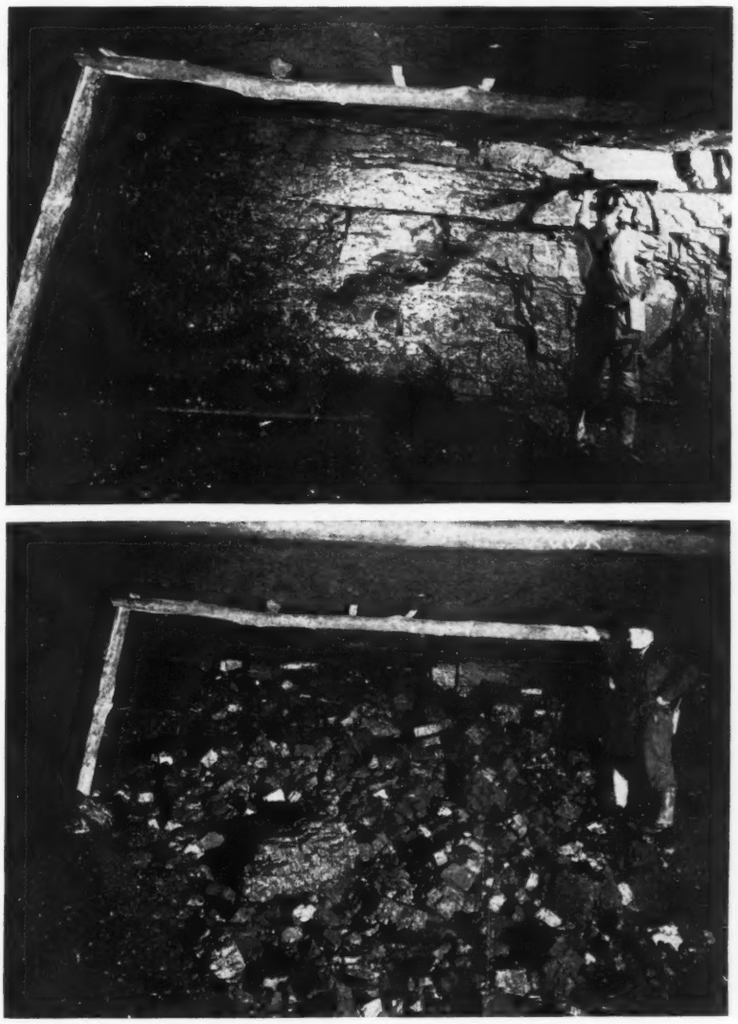


Fig. 10—Drilling plans for universal and shortwall cutters. Robinson Run No. 2 mine, including plan for headings top cut and sheared on both sides.

Fig. 11—Typical drilling plans for bottom cutting, bottom cutting and shearing, and top and bottom cutting and shearing. Jamison mines.

haulage headings are driven 11 ft. wide; other headings and rooms 12 ft.; and pillar places, 15 ft. Shortwall places 12 ft. wide at No. 8 normally are shot with three holes, including one breaker drilled just under the triple parting some 5 ft. above the bottom (Fig. 11). This breaker hole is angled down some 12 in. so that the charge will kick out the bottom coal. It is shot first, after which the loads for the top holes are judged by conditions. In 15-ft.-wide places, three top holes are drilled. Bottom-cut places 12 ft. wide at No. 9 normally are shot with four holes, inasmuch as a 9-ft. bar permits a substantially deeper cut than the 7-ft. shortwall bar at No. 8. In other respects, the shooting plan is substantially similar to No. 8.

With the 29-U machines the usual practice is to bottom cut and shear over one rail, as shown in Fig. 11. One top hole then is drilled on each rib, with a third snubber hole on the wide side just under the triple parting and 3 ft. from the shear. In headings, particularly those designed for haulways, places also are top-cut in addition to bottom-cutting and shearing to decrease the effect of shooting on the top coal left to hold the drawslate. With such an arrangement, the usual shooting plan is based on two holes along the ribs and just above the partings.



Above, loading an undercut face with five carbon-dioxide shells in Eagle mine; below, the same face after the coal has been broken down.

Four Holes Drilled

Driving headings 9½ ft. wide and rooms and pillar places about 14 ft. wide, and taking about 6 ft. 9 in. of Pittsburgh coal, Dawson No. 2 mine of the Dawson Coal Co., in Harrison County, was using both 29-U and Goodman 12-EA shortwall equipment in its mechanical-loading sections at the time of the *Coal Age* survey. Whiteman standard bits in standard-kerf chains were being used, with a bar length of 9 ft. on the 29-U and 7 ft. on the 12-EA equipment. Drilling is done with Jeffrey A-6 post-mounted units. Four holes normally are drilled in shortwall places about as in Fig. 12, with the bottom holes pointed slightly down for extra kick. Places in the 29-U sections are center-sheared in addition to bottom-cutting, and are shot with two holes in the top, as indicated in Fig. 12. Shooting is done with 1½x8-in. Lump Coal C, and about 20 per cent more powder is required in driving places on the butts.

CO_2, supplemented by powder under certain conditions, is used for breaking down coal at the Eagle mine of the Getty Coal Co., in Harrison County. Places at Eagle range from 14 to 19 ft. in width, the former considerably in the majority. In most cases, the entire thickness of 8 to 8½ ft. of Pittsburgh coal is taken. In soft pillar work, in particular, however, a foot of head coal may be left, in which case powder is employed in the upper bench. Powder also is employed in the last cut next the gob in pillar places to guard against the loss of carbon-dioxide shells.

Cutting at Eagle is performed by Sullivan 7-AU universal and Goodman standard and Jeffrey 35-BB shortwalls, all with 9-ft. bars. The 7-AU machine carries a Sullivan drill, while shortwalls are accompanied by A-6 and CP post-mounted drills. Cardox augers and cutting heads are used to make a hole approximately 3 in. in diameter to accommodate the 200-cu.in. Cardox shells employed. Cardox was put in on the basis that the increased realization from a rise in coarse-coal percentage would more than compensate for the extra cost. To date, its use is reflected in a decrease of about 10 per cent in the yield of minus 1-in. slack. Better movement of the coal out from the face is reflected in increased loadability, with the result that a loading machine saves about 10 to 15 minutes in a place making 30 tons.

Shearing is the usual practice with the 7-AU machine in solid coal and also in pillars provided there is no weight. The shear is made in the center and such places are broken down with two holes in the top, as shown in Fig. 13. Bottom-cut places are broken down with five holes, two of which are drilled below the double band which appears 4 to 4½ ft. above the bottom (Fig. 13). In soft pillar work where head coal is left, however, the three top holes in a bottom-cut place are shot with Coal-

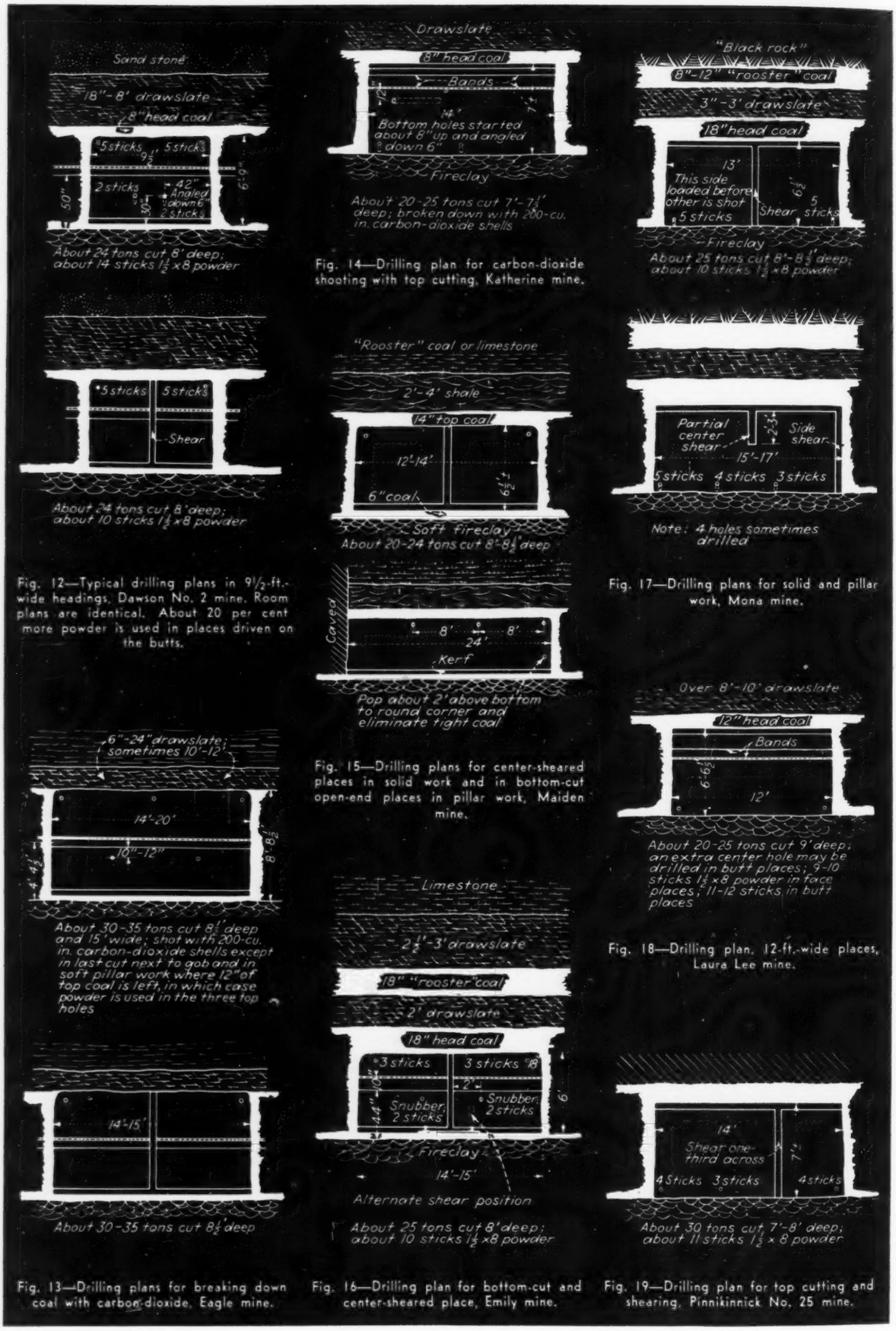

Sand stone
18"-8' drawslate
8" head coal
5 sticks
5 sticks
2 sticks
42"
Angled down 6"
2 sticks
50"
6'-0"
About 24 tons cut 8' deep; about 14 sticks 1½ x 8 powder
5 sticks
5 sticks
Shear
About 24 tons cut 8' deep; about 10 sticks 1½ x 8 powder
Drawslate
8" head coal
Bands
14'
Bottom holes started about 8" up and angled down 6"
Fireclay
About 20-25 tons cut 7'-7½' deep; broken down with 200-cu. in. carbon-dioxide shells
"Rooster" coal or limestone
2'-4' shale
14" top coal
12'-14'
6" coal
Soft Fireclay
About 20-24 tons cut 8'-8½" deep
Caved
8'
8'
24'
Kerf
Pop about 2' above bottom to round corner and eliminate tight coal
6"-24" drawslate; sometimes 10'-12'
14'-20'
10"-12"
About 30-35 tons cut 8½' deep and 15' wide; shot with 200-cu. in. carbon-dioxide shells except in last cut next to gob and in soft pillar work where 12" of top coal is left, in which case powder is used in the three top holes
14'-15'
About 30-35 tons cut 8½' deep
Limestone
2½'-3' drawslate
18" "rooster" coal
2' drawslate
18" head coal
3 sticks
3 sticks
Snubber; 2 sticks
Snubber; 2 sticks
Fireclay
14'-15'
Alternate shear position
About 25 tons cut 8' deep; about 10 sticks 1½ x 8 powder
"Black rock"
8"-12" "rooster" coal
3"-3' drawslate
18" head coal
13'
This side loaded before other is shot
5 sticks
Shear sticks
Fireclay
About 25 tons cut 8'-8½' deep; about 10 sticks 1½ x 8 powder
Partial center shear
Side shear
15'-17'
5 sticks
4 sticks
3 sticks
Note: 4 holes sometimes drilled
Over 8'-10' drawslate
12" head coal
Bands
12'
About 20-25 tons cut 9' deep; an extra center hole may be drilled in butt places; 9-10 sticks 1½ x 8 powder in face places; 11-12 sticks in butt places
14'
Shear one-third across
4 sticks
3 sticks
4 sticks
About 30 tons cut 7'-8' deep; about 11 sticks 1½ x 8 powder

Fig. 12—Typical drilling plans in 9½-ft.-wide headings, Dawson No. 2 mine. Room plans are identical. About 20 per cent more powder is used in places driven on the butts.

Fig. 13—Drilling plans for breaking down coal with carbon-dioxide, Eagle mine.

Fig. 14—Drilling plan for carbon-dioxide shooting with top cutting, Katherine mine.

Fig. 15—Drilling plans for center-sheared places in solid work and in bottom-cut open-end places in pillar work, Maiden mine.

Fig. 16—Drilling plan for bottom-cut and center-sheared place, Emily mine.

Fig. 17—Drilling plans for solid and pillar work, Mona mine.

Fig. 18—Drilling plan, 12-ft.-wide places, Laura Lee mine.

Fig. 19—Drilling plan for top cutting and shearing, Pinnikinnick No. 25 mine.

ite, as under these circumstances powder is the cheaper medium.

Maiden mine of the Kelleys Creek Colliery Co., in Monongalia County, in comparison with the other operations described above, is one of the class using track-mounted cutting and shearing equipment exclusively; i.e., 7-AU and Jeffrey 29-LE machines with 9-ft. bars. Standard-kerf chains with Warwood quenched bits are employed. All cutters carry their own drills, either of the Sullivan or Jeffrey A-6 type, using McLaughlin conveyor-type augers, heads and bits.

Places in solid work at Maiden, where about 6½ ft. of Pittsburgh coal is mined, are 12 or 14 ft. wide. In open-ending pillars, places are about 24 ft. wide. Bands and rock frequently are encountered in the coal, with the result that both the type and quantity of explosive used vary materially. Normally, 1½x8-in. Lump Coal C is employed, but where much rock or sulphur is present holes are loaded with Duobel or Gelobel. In solid work, places are cut either on the top or the bottom. Solid places also are sheared in the center and normally are shot with two holes in the top placed about as shown in Fig. 15 (vice versa in top-cut places). Open-end places in pillar work normally are bottom-cut only and are shot with three holes in the top (Fig. 15), supplemented by a pop on the solid rib near the bottom. The latter hole assures a rounded corner in going into a place, and also eliminates tight corners in succeeding cuts.

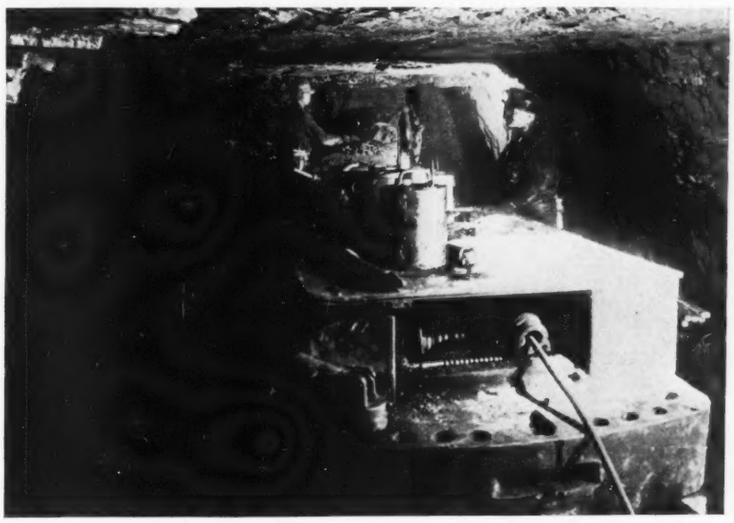
Coal Cut and Sheared

Coal at the Emily mine of the Monongahela Rail & River Coal Corporation, in Monongalia County, is bottom- or top-cut and center-sheared by 7-AU and 29-LE machines with 8- and 9-ft. bars. The 7-AU machine is equipped with a Bowdil chain and bits which, in addition to lower bit cost and greater efficiency, have reduced power consumption 30 per cent, decreased armature and gear trouble and lengthened the life of the safety clutch. Jeffrey A-7 hand-held drills with McLaughlin twisted augers, heads and bits are used, along with 1½x8-in. Lump Coal C and du Pont electric detonators.

About 6 ft. of the Pittsburgh seam is taken at Emily, where places are driven 14 and 15 ft. wide. Normally, places are bottom-cut, but where conditions warrant it top-cutting is practiced. With the 7-AU machine, the shear is made in the center; with the 29-LE, approximately over one rail of the track. One or two snub holes are drilled below the double parting about as shown in Fig. 16, supplemented by two top holes on each rib. Strict control of bugdusting of bottom cuts is the rule over the district to avoid tight shots and hard digging, but at Emily the management goes still further with a regulation that before a shot is fired the section boss' permission must be obtained. And he is required to go and inspect the place, seeing, in particular, that a thorough job of bugdusting has been done. The resultant looser falls have done much to reduce the wracking of loading machines and thereby has cut maintenance.

The shooting plan at the Mona mine of the Arkwright Coal Co., in Monongalia County, is another designed on the basis of considerable experimentation to insure the same results in spite of the normal variations from the rules to be expected in actual practice. As indicated in the preceding article, all places are driven on an angle at Mona, where about 6½ ft. of Pittsburgh coal is recovered. While this leaves no places directly on the face, the departure is not sufficient to noticeably affect shooting or loadability, while at the same time gentler curves are possible. Solid places in the working sections at Mona usually are 13 ft. wide, while the width of pillar places, driven with a thin saw-toothed fender next the gob, is around 15 to 17 ft.

Cutting at Mona is done by 7-AU machines with 9-ft. bars (standard-kerf chains and Warwood and Dukane bits). Drilling is done by Jeffrey 56-A single-spindle track-mounted units. The explosive is 1½x8-in. Duobel C. Originally, in solid work, the practice was to top-cut and shear on one side. Three holes were drilled



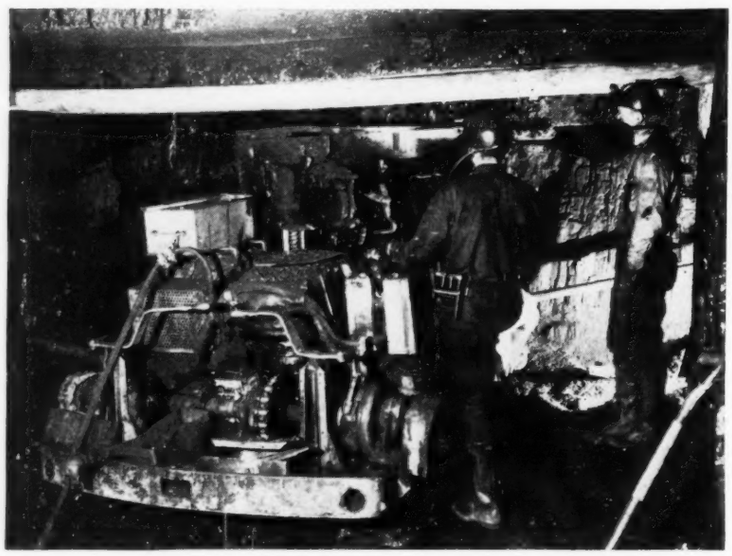
Vertical shearing with a track-mounted machine at Emily mine.

A pillar place in Mona mine showing the full shear to form the fender on the gob side at the right and the partial center shear to provide additional room for expansion.

to shoot a place, but it was found that unless great care was taken in locating holes one often would be of little use. Consequently, a change was made to center shearing, as shown in Fig. 17, with one hole on each rib. In addition to reducing the number of holes to be drilled, the new system made it unlikely that reasonable variations from drilling standards would materially affect shooting and loadability. The practice is to shoot one side and then load five cars—the usual trip. Then, while the locomotive goes after another trip, the other side is shot. The large free space results in better coal and easier loading.

Shearing on the side next to the gob was continued in pillar work, but with the addition of a partial shear extending down about 2 or 3 ft. from the top in the center to provide additional room for expansion, which experience indicated was necessary for best results. The position of this partial shear is shown in Fig. 17, and its adoption, the management has found, has cut powder consumption, improved the coal and facilitated loading. With the full side and partial center shears a pillar place normally is shot with three holes in the bottom, although in wider places four may be drilled, without, however, any increase in powder used.

With track eliminated, three of the operations using rubber-tired haulage equipment covered by *Coal Age* have gone to the use of cutting equipment mounted on caterpillar trucks. At the Katherine mine of the Katherine Coal Mining Co., in Harrison County, Jeffrey 29-C arcwall equipment, 8-ft. bars, has been equipped with "eats" for top-cutting. Drilling is done both with Chicago Pneumatic post-mounted and a Sullivan CD-16 rubber-tired drilling machine with hydraulically controlled drill boom. As at Eagle, 200-cu.in. Cardox shells are used for shooting, supplemented by Genite 4 in places next to gob, etc., where there is a possibility of shell loss. Usual place width at Katherine is 14 ft., and four holes normally are drilled. Three at the bottom angle down to the floor at the back, with a fourth breaker hole about half way up the face and angled toward the center as in Fig. 14. Cartridges are charged with 6 lb. of CO_2. In addition to increasing loadability at the face, Cardox has lowered production of minus 1-in. slack to around 30 per cent, as compared with 45 per cent minus ¾-in. slack with powder.



A turret-type slabber mounted on caterpillars does the top-cutting at Laura Lee.

This caterpillar-mounted machine both cuts and shears in the rubber-tired-haulage section at Pinnikinnick No. 25 mine.

Cutter on Caterpillars

Place width at the Laura Lee mine of the Hutchinson Coal Co., also in Harrison County, usually is 12 ft. and about 6 to 6½ ft. of Pittsburgh coal is taken. Unusually bad top at this operation was an argument both for reducing place width and top cutting, which is performed by a rebuilt Goodman 148-B turret slabbing machine with 9½-ft. bar mounted on caterpillars. CP hand-held and post-mounted drilling equipment is used, with Cardox augers and cutting heads. Face places normally are shot with two holes, as indicated in Fig. 18. Butt or quarter-butt places usually require three holes. The explosive is 1½x8-in. Duobel C.

Both top-cutting and shearing are done at the Pinnikinnick No. 25 mine of the Consolidation Coal Co., another Harrison County operation and the third in northern West Virginia to install rubber-tired haulage equipment. For this purpose, a Jeffrey 29-LE machine with 9-ft. cutter bar was mounted on caterpillars. Because shearing is done in addition to top-cutting, and because the machine is rather slow-moving, three cutting shifts are necessary to supply coal for two loading shifts. Holes are put in with an A-6 post drill, and the explosive is 1½x8-in. Lump Coal C. About 7 ft. of Pittsburgh coal is taken and place width in solid work is 14 ft. The shear at No. 25 is made about one-third of the distance across the place, as indicated in Fig. 19, and the coal is shot with three holes in the bottom.

TRANSPORTATION

+ At Northern West Virginia Mechanical Mines

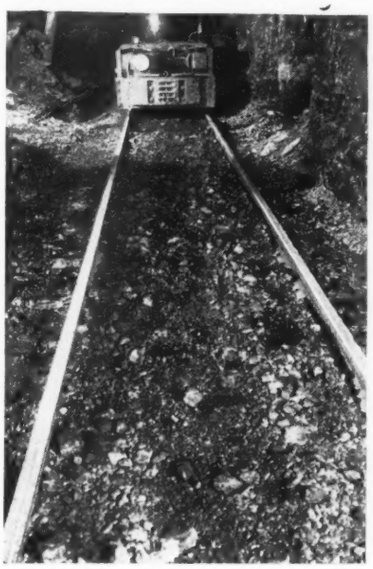
LONG HAULS from the face to the shaft bottom or dump are the rule at mechanized mines in the Fairmont field of northern West Virginia. This reflects the fact that most of them were opened twenty years or more ago. One result, also influenced by the advent of loading machines with their radically different car-changing problems, is the division of haulage into three stages—gathering, relay and main-line. Lengthening hauls also have emphasized the need for maximum efficiency in main-line transportation, in turn bringing about a trend to larger equipment—either single locomotives or tandem units—heavier track and ties, grading to eliminate hills, cutting off distance by the construction of new openings or bridges, etc. And to reduce maintenance of mine roads, in addition to promoting trouble-free operation, a number of mines have gone to treating ties and welding rails.

With rail weights on main lines going up to 85 lb., corresponding increases have been made on secondary routes and in working sections. In the latter, in particular, the use of heavy track-mounted equipment and larger cars in most operations has resulted in raising rail weights to 40 lb. Mechanical loading also has stimulated steel ties and steel-tie switches, not only because they are faster to lay but also because they provide more height over the rear conveyor of loading machines and thus avoid breaking lumps against the roof and wear and tear on conveyor chains.

Relatively small mine cars held over from hand-loading days still are used by many mines, largely because mechanical loading is so new that a number of organizations have not yet gotten around to revising car equipment. However, larger cars are coming into use in increasing numbers and where shaft sizes are not a factor the top limit of capacity has been set by some operators at 10 tons or more. As might be expected, pressure for larger equipment grows out of the desire to reduce the number of changes necessary for a given tonnage and thus increase loading-machine output. At three operations at the time of the *Coal Age* study, the question of providing a big changing unit had been solved by installing rubber-tired haulage units (see article beginning on p. 51), at the same time retaining the original small mine cars for main-line work.

Drift operations are in the majority in northern West Virginia, inasmuch as the coal normally lies in hilltops above drainage. In the group studied by *Coal Age,* three employed

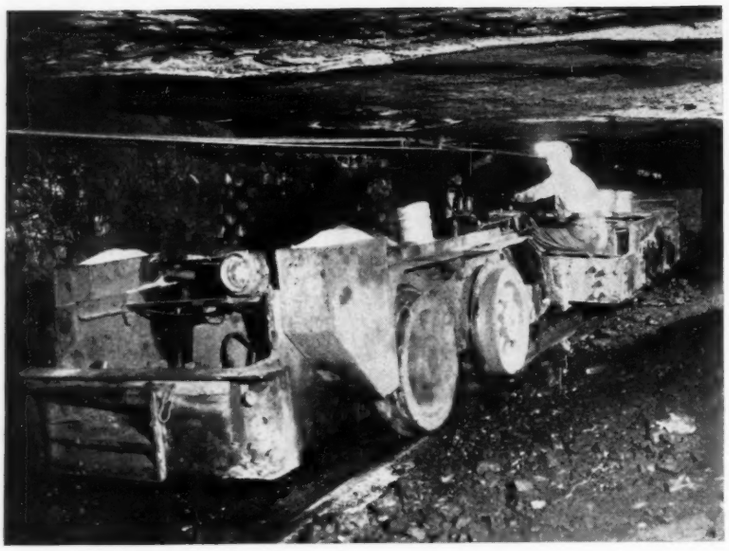
A section of steel-welded 80-lb. track on 5x7-in. creosoted ties in Pursglove No. 15 mine, with a 15-ton haulage locomotive in the rear.



mine-car slopes and one a conveyor slope. Four, all in Marion County, were shaft operations, including Federal No. 1 mine, Koppers Coal Co., equipped with a 900-hp. cylindro-conical Ottumwa hoist (900-hp. General Electric motor) capable of handling three cars weighing 5,200 lb. and holding 3¾ tons of coal per minute. Shaft depth is 255 ft.; total hoisting distance is 301 ft. Nolan automatic cagers are used on the bottom, with Roebling 1⅛-in. rope on the cages. Usual rope life at No. 1 is 500,000 tons.

Although not at present operated at that rate, the hoist at Rachel mine, Jones Collieries, Inc., has handled as many as 1,200 cars in eight hours. Car weight is 3,800 lb.; capacity, machine loaded, is 2.7 to 2.8 tons. The hoisting shaft is 365 ft. deep and is timbered with yellow pine. Total hoisting distance is 425 ft. and cars are caged automatically. A Vulcan conical-drum hoist driven by a 700-hp. Westinghouse motor is used, with 1¼-in. American Steel & Wire Co. rope.

Shaft depth at Jamison No. 8 mine, Jamison Coal & Coke Co., is 265 ft., while hoisting distance is 325 ft. The shaft is timbered and Nolan cagers are used on the bottom, protected by brick-arch construction. Hoisting capacity is three cars per minute, although the average normally is two. Cars are handled by a Connellsville straight-drum unit powered by a Westinghouse 700-hp. motor. Wickwire-Spencer 1¼-in. regular-lay rope is used. A similar single-drum hoist and size and type of rope are used at Jamison No. 9, although the motor is only 450-hp. Depth of the timbered hoisting shaft is 360 ft.; total hoisting distance is 420 ft. Caging is manual and hoisting capacity (cars weighing 2 tons and holding 2.2 to 3 tons of coal)



Two 6-ton cable-reel locomotives make up this tandem unit in relay service at Louise mine pulling 14- to 15-car trips.

is two cars a minute (usually 85 to 90 per hour). The bottom is protected by 18-in. I-beams on brick side walls.

Mine-car slopes covered by *Coal Age* include an endless-rope job at the Pinnikinnick No. 25 mine, Consolidation Coal Co., Harrison County. Length of the slope, including the outside grade to the dump, is 600 ft., knuckle to knuckle, and a grip car is employed to raise and lower cars in trips of three or four. A 350-ft.-long slope on an inclination of 35 per cent serves the Bunker mine, Davis-Wilson Coal Co., Monongalia County. Total hoisting distance, including an outside trestle leading up to a one-car rotary dump in the top of the tipple, is 540 ft. Cars weighing 3,200 lb. and holding 3½ tons of coal are handled in trips of three or four by a 40-in.-diameter 3-ft.-face single-drum friction-clutch Ottumwa hoist driven by a 150-hp. General Electric wound-rotor motor. Motor and hoist are set on the ground back of the tipple and are remotely controlled from the dumping station by means of wire cables, etc. The usual operating rate is 36 cars per hour. Wickwire-Spencer 6x19 regular-lay rope is used.

Continental No. 4 mine, Continental Coal Co., Monongalia County, employs a slope driven 7 ft. high and 15 ft. wide on a pitch of 33 per cent to permit hoisting in balance. This slope replaced a shaft hoist, now used for men and materials. Slope length is 600 ft.; total hoisting distance is 800 ft. Hoisting is done by a double-drum Ottumwa unit (stepped drums) driven by a 400-hp. General Electric motor. Leschen 1¼-in.-diameter rope is used. A rope, turned end for end before being discarded, usually handles 3,000,000 tons. "Brownie" Timken-bearing slope rollers are installed. Car weight is 3,850 lb.; capacity, 3 tons. On this basis, the slope has handled a record of 216 cars (four-car trips) in one hour, although the usual average (three-car trips) is 160. Running time with four-car trips, one study showed, is 48 seconds, while a complete trip requires 1 minute 13 seconds.

Two tracks are laid on each side of the slope. A trip comes up one track to a four-car Roberts & Schaefer rotary dump in the top of the tipple and then is dropped down to a switch which throws it over onto the second track offset a foot from the first. On this second track, the empties go back to empty track on the bottom, which lies between the two loaded tracks. A similar arrangement of two tracks, rotary dump, etc., is installed on the other side of the slope. The hoist, set on the ground, is remotely controlled from the dumping station in the tipple. To assist the hoistman, who faces the rotary dumps, loaded-trip position is shown by a row of signal lights turned on in succession by a button-type contact dial which replaced the usual indicator dial on the hoist. White markers by certain lamps show when to begin slowing up.

The Continental No. 4 hoist is unique in that, while it is stepped, it is stepped in the reverse direction. In other words, loaded trips are started on the full-diameter section of the drum and step down to a stop, instead of the usual system of stepping up to a stop. This was done to slow down the trip as it enters the dump, reducing controller operations, while at the same time the empty trip is running at high speed when it hits the bottom and thus has momentum enough to pull down the rope.

An apron-type conveyor, 228 ft. long on a 25-deg. pitch and driven by a 60-hp. motor, brings coal up the slope serving the Pursglove No. 15 mine, Pursglove Coal Mining Co., Monongalia County. Conveyor width is 48 in.; approximate speed is 100 f.p.m.; and normal capacity is 300 tons per hour. A crossover dump on the bottom discharges the coal into a 10-ton bin, from which a plate feeder moves it out onto the conveyor. The installation is operated by three men.

Main-line hauls at northern West Virginia mechanized mines ranges from 1 to 3½ miles but seldom are less than 2 miles, in addition to relay hauls of 1,000 to 5,000 ft. Grades normally are against the loads on main lines and frequently on relay hauls, while car capacity (mechanically loaded) varies from 2 to 6 tons. Single haulage locomotives weighing from 8 to 20 tons are used on main lines, while tandem units run from 20 to 30 tons. In the relay category, although a number of gathering-type units are pressed into service, the tendency is to use units weighing 10 to 15 tons, including some 10-ton battery locomotives and one 12-ton tandem machine.

Single Tracks Used

Main haulage, with the exception of a very few double-track installations, is single-track. As haulage units seldom number less than two, interference is prevented by passing tracks at strategic points or by having locomotives pass at junctions. As a further precaution, dispatching has been inaugurated at several mines. Under the conditions and with the equipment reviewed above, main-line trip size ranges from 15 to 60 cars (generally 15 to 30), as compared with 5 to 40 cars (usually 5 to 15) for relay trips.

Bunker mine uses the smallest haulage locomotives of any operation in the *Coal Age* survey and also is one of the few without relay units. One Westinghouse and one Jeffrey 8-ton locomotives are in service, each operating to an individual sidetrack 2 miles from the slope bottom. Two passing tracks are provided along the single-track main line, on which the maximum grade against the loads

is 7 per cent for about 1,000 ft. Consequently, trip size is limited to twelve cars. Mine-car equipment comprises 100 Watt composite (steel with wood bottom) cars with Helmick-Timken chilled wheels. With solid ends for a rotary dump, these cars weigh 3,200 lb. and hold about 3½ tons mechanically loaded.

One of the several operations building new haulways to cut grades or distance is the Louise mine, Louise Coal Co., Monongalia County. Two main partings, one about 1 mile and the other 1½ miles from the dump, serve the mine. Except that end gates are installed, mine-car equipment is practically identical in design and capacity with that at Bunker. The number in use also is the same. Main haulage is handled by a 10-ton Goodman locomotive, while relaying is done by the only tandem unit in the field, made from two 6-ton General Electric cable-reel machines, one fitted with two extra-large sand boxes. Both the main and tandem units handle fourteen- to fifteen-car trips. A single-track main line with passing tracks is in service.

Hump Cut Off

A hump in the main line just inside the drift mouth was the major reason for the decision to build a cut-off line. This hump forces loaded trips to pull up a 4- to 5-per-cent grade and then slide down a 7- to 8-per cent incline to the tipple, up which the empties must be pulled in return. As a result, a new outside road about a half mile long is being built to terminate in an 800-ton storage bin. Grade on this road is about ½ per cent in favor of the loads, and the power savings alone, it is expected, will pay for the job in a few months.

A new haulway to eliminate two locomotives also is under way at the Continental No. 4 mine. Haulage equipment is made up of two 10- and four 13-ton Goodman and one 13-ton Jeffrey locomotives. Five of these units are in use hauling from three sections 2 to 2.9 miles from the slope bottom. Extreme grade against the loads is 4 per cent and usually is 2 to 3. Consequently, trip size (Bethlehem composite cars, 3,850 lb., holding 3 tons and equipped with A.C.F. wheels with Tyson and some Timken bearings—500 cars in use) generally is 24 cars. Relay locomotives consist of two 6-ton General Electric cable-reel units with 8-ton equipment and one 6-ton Jeffrey machine. These locomotives handle fifteen- to eighteen-car trips over distances of 1,000 to 3,000 ft.

With the above number of main-line units operating over a single-track main line—with passing tracks—a telephone dispatching system naturally was in order at Continental. Both main-line and relay units are brought under the dispatcher's control. The new haulway will be about two miles long and will be level except for one stretch of 1,000 ft. with a 1-per-cent adverse grade. With this line completed a 15-ton locomotive will pull 50-car trips from a three-way parting and three machines now operating to this section will be retired.

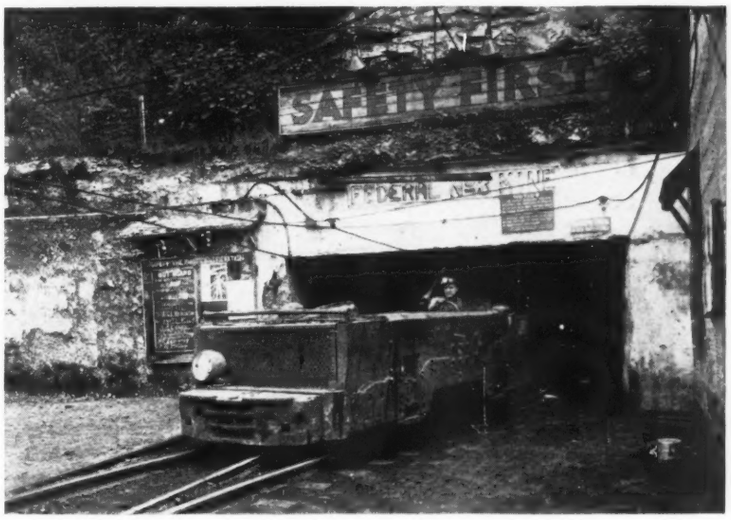
A double-tracked main line characterizes haulage at the Pursglove No. 2 mine, Monongalia County, with loaded and empty tracks in separate headings. This track set-up is supplemented by dispatcher control, also extended to the control of power peaks by prohibiting the starting of trips on a grade while another also is operating over a hill. The main haul at No. 2 is around 2½ miles to a Roberts & Schaefer compressed-air-operated rotary dump at the preparation plant. Maximum grade against the loads is 3 per cent. Two 15-ton Jeffrey locomotives haul trips of 28 cars holding 2½ tons each (276 in use). Relaying is handled by one 8-ton and two 6-ton Jeffrey cable-reel units, which pull ten to fifteen cars. Relay hauls usually are nearly level.

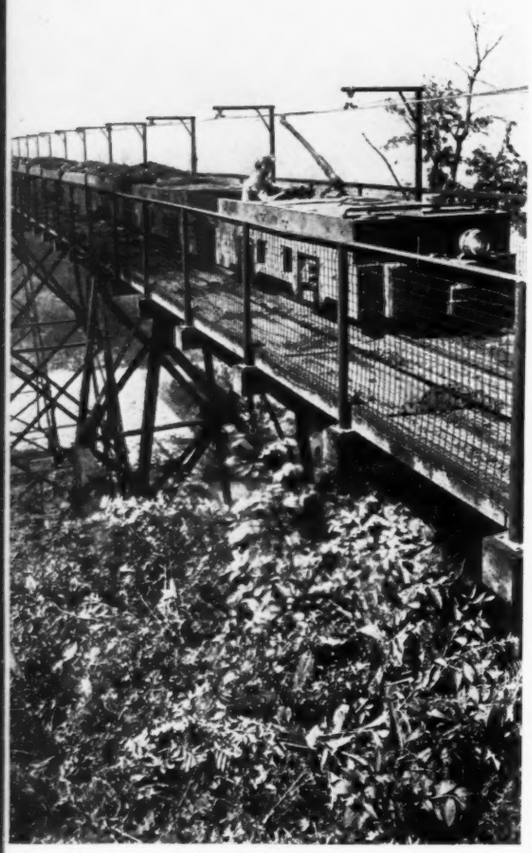
Grading one section of the main line, as will be detailed later in this article, permitted an increase of five cars in trip size, as well as the discontinuance of one locomotive at Pursglove No. 15 mine. Main haulage now is handled by two 15-ton Jeffrey locomotives, with a 13-ton unit as a spare. The two working machines pull from two partings 2¾ and 3½ miles from the slope bottom. As a result of reconstruction, maximum grade against the loads now is 3 per cent and trip size (2¾-ton endgate-type cars—250 in use) is 30 cars. "B"-side relay work is handled by a 6-ton General Electric cable-reel locomotive, with two 8-ton Jeffreys on the "A" side. Relay hauls usually are nearly level and trips average 20 cars on "B" side and 15 on "A" side.

Two-stage main-line haulage is the system at the Rosedale mine, Rosedale Coal Co., Monongalia County. Main-line locomotives are a 15-ton General Electric machine and a second 15-ton Jeffrey unit with 20-ton equipment. One locomotive operates over a 1-mile haul from two partings inside the mine (3- to 4-per-cent adverse grades in places) to a transfer parting just inside the pit mouth, where the second machine takes the trips for a 2-mile outside haul on a favoring grade to the tipple. Usual trip size is 25 cars, and a trip is made about every half hour during the shift. Mine cars total 150 and are of two sizes. One weighs 2,800 lb. and holds 2¼ tons and the other weighs 3,900 lb. and holds 4¼ tons. Relay work is handled by one 10- and one 13-ton General Electric units. Usual relay haul is 1 mile; trip size, twelve cars.

Reopening of the Emily mine by the Monongahela Rail & River Coal Corporation, Monongalia County, March 1, 1935, on the mechanical basis was accompanied by the installation of 6-ton Sanford-Day solid-end cars (Roberts & Schaefer rotary dump). Car average, based on shipped weights, is 5.2 tons. Number in use is 64 and the design in-

Coming out, after finishing a shift, is one of the 15-ton haulage units at Federal No. 3 mine.





This steel bridge, one of four on the outside haul at Maiden mine, cut off a 1¼-mile run through an old working section. Also shown is one of the three tandem locomotives at this operation.

cludes steel construction, "Floater" wheels with Fafnir ball bearings, wood bumper inserts and drop gates on the back to accommodate the rear conveyors of loading machines.

The main-line haul at Emily is about two miles, with a grade of about 2½ per cent against the loads to the pit mouth and then 1½ per cent down to the tipple. Trips comprise fifteen cars and require about 45 minutes. One 10-ton Westinghouse locomotive works on the head end of each trip, with an 8-ton Jeffrey pusher on the rear for safety in addition to power. The main line naturally is single-tracked. One 10-ton Westinghouse relay locomotive is in service and operates between the main parting and three gathering partings 1,000 to 2,500 ft. away. Grades usually are about 3½ per cent against the loads and the normal trip is 5 cars.

A new 20-ton high-speed Jeffrey trolley locomotive, installed in October, 1938, handles main haulage at the Mona mine, Arkwright Coal Co., Monongalia County. Length of the main haul is 9,000 ft. from inside parting to dump, and the route is through a worked-out territory, across a wooden bridge and into the active section of the mine. The grade against the loads averages 3 per cent, and the normal trip is 20 cars (3-ton wood, Irwin-chilled wheels with Timken and Hyatt bearings, 238 in service). Under these conditions, the locomotive makes a round trip in 20 minutes. Relay service between the main parting and the working sections (favoring grade) is handled by a 6-ton Jeffrey cable-reel locomotive, which also pulls 20-car trips.

Big cars also were adopted as a necessary adjunct to mechanical loading in opening the Robinson Run No. 2 mine, Christopher Mining Co., Monongalia County, in 1938. This opening involved constructing a haulage road from a site on a hill facing the Monongahela River 3,000 ft. through the old Harmar mine and across a hollow into the Robinson Run acreage. Maximum grade against the loads is 2½ per cent and the average, obtained by grading in Harmar, is 2 per cent. A total of 122 Sanford-Day 5-ton steel drop-bottom cars weighing 6,500 lb. each and equipped with spring bumpers and "Floater" wheels with Fafnir ball bearings, are in service. These dump coal into a 200-ton bin at the headhouse, which is accompanied by a six-car rock bin.

The main line at Robinson Run is a single-track job with sidetracks and passing tracks at strategic points. Length of the haul from the dump to each of two sections is 8,500 ft. From these sections two new General Electric trolley locomotives pull sixteen-car trips to the outside. One 15-ton Goodman relay locomotive also is in service, hauling sixteen-car trips from two gathering sidetracks a distance of about 2,500 ft. over grades of around 1½ per cent against the loads.

Steel Bridges Built

Four steel bridges and tandem locomotives are major features of the haulage system at the Maiden mine, Kelleys Creek Colliery Co., Monongalia County. The haul from the dump to the inside (two sections) is 3¼ miles, made up of 2 miles inside, on which the grade, after cutting and filling, runs as much as 3 per cent against the loads, although normally less, and 1¼ miles outside with a favoring grade. Trips come out of the mine and across Robinson Run on one steel bridge, then down the run over two more bridges and back across the fourth bridge to the preparation plant. One of the bridges, built in 1938, cut off a 1¼-mile inside haul through an old section of the mine, on part of which the grade in favor of the loads was 12 per cent. Timbers used in this bridge are white oak seasoned 40 days and painted with "No-D-K," followed after installation by a second "No-D-K" coat.

Three tandem locomotives pulling 35- to 40-car trips serve Maiden mine. Two of the units are made up, respectively, of 15-ton Goodman and 15-ton Jeffrey locomotives. The other consists of two 10-ton Westinghouse locomotives. Mine cars hold about 5 tons of raw coal and 374 of various types are in use, 74 with wood bottoms and the remainder all steel. The all-steel equipment includes 100 new Phillips cars with Timken bearings. Relay equipment at Maiden comprises two 15-ton Jeffrey and Westinghouse and two 13-ton Westinghouse machines, of which three normally are in service. Maximum relay haul usually is 1,000 to 1,500 ft., and trip size varies.

Safety Locomotive Used

A safety locomotive also is used on the back end of main-line trips at Federal No. 3 mine, Koppers Coal Co., Monongalia County. The main haul at this mine is about two miles long, with approximately a mile of passing tracks. Maximum grade against the loads is 3½ per cent and the average over the route is 2. A total of 390 wood cars holding 2.4 tons are in use. Two 15-ton Goodman locomotives are used on the main line, with a 20-ton machine as a spare. Trips consist of 30 cars followed in all cases by a 10-ton Westinghouse machine to prevent accidents in case a coupling breaks. Two 10-ton Westinghouse relay units are in service, usually handling 20-car trips over an average haul of ¾ mile. At the Federal No. 1 mine all cars are equipped with Climax automatic couplers.

A mile of double-tracking and battery-type relay locomotives distinguish Rachel mine, in Marion County. Length of the main haul is 2 miles, of which 5,000 ft. is double-tracked, with empty and loaded tracks in separate headings. Grades against the loads average around ½ per cent, and one Goodman 10-ton locomotive with 13-ton equipment hauls 30-car trips to the shaft bottom. Cars weigh 3,800 lb. and hold 2.5 to 2.7 tons. Two 10-ton Whitcomb locomotives with Gould batteries, which formerly were used on the main line, now handle relay service at Rachel. The grades normally are against the loads on the relay hauls, which vary from 1,800 to 2,000

ft. on one to 3,300 ft. on the other. Relay trips usually comprise ten cars.

An average grade of ½ per cent against the loads enables the two 15-ton main-line locomotives at Jamison No. 8 mine to pull 60-car trips over the 2-mile haul from the main parting to the shaft bottom. A single track with passing tracks is provided in accordance with usual practice. A total of 590 steel and wood mine cars of various capacities are used, including 150 Bethlehem all-steel units with 12-in. chilled Timken-bearing wheels. One 10-ton Jeffrey relay locomotive handling 20- to 40-car trips operates between the main parting and four gathering partings about a mile away.

Jamison No. 9 mine employs two-stage main haulage over a route on which the average grade against the loads is 1 per cent; maximum, 2 per cent. Trip size is 40 cars (2.2 to 3 tons, including a number of new Bethlehem all-steel cars). One 15-ton locomotive operates between the shaft bottom and a junction about 1½ miles away, while the second works from the junction to a run-around, ½ mile. Two 12-ton Jeffrey relay locomotives are used, these hauling 25 cars as a rule over an average distance of ½ mile.

Dispatchers Control Trips

Dispatchers control the operation of the 10-ton General Electric and Jeffrey main-line locomotives at Katherine mine, Katherine Coal Mining Co., Harrison County, where the main (single-track) haul is 7,000 ft. long and trips of 46 2½-ton cars are handled. A single-track main line also is installed at Laura Lee mine, Hutchinson Coal Co., Harrison County, where one 10-ton General Electric locomotive hauls 40-car trips on one shift and a 10-ton Westinghouse on the other. Car capacity is 2 tons and the locomotive on each shift has only the duty of taking care of the output of one loading machine.

Eagle mine, Getty Coal Co., Harrison County, was another to accompany loaders with big cars and now is using 116 Sanford-Day steel bottom-dump cars weighing 4,800 lb. and holding 5 tons. Equipment includes spring draft gear and "Floater" wheels with Fafnir ball bearings. Eagle also is one of the few operations without relay locomotives. Main-line locomotives run from the dump directly to the gathering sidetracks serving the four working sections an average of 2 miles inside. The main line is single-tracked with passways as needed. However, in the Eagle side (the mine is a combination of the old Eagle and Erie operations), the empties travel one route into the mine and the loads come out another past the Erie-side pit mouth. As the main line goes through several hills, a number of bridges have been built. A slight grade against the loads is the rule. Two 13- and one 10-ton Jeffrey locomotives are on hand, of which two are in use pulling 15-car trips. The cars dump into a 200-ton bin.

Dawson No. 2 mine, Dawson Coal Co., Harrison County, is reached by a haulway through old No. 1 mine and across a steel bridge. The grade in the mine generally is about 1 per cent in favor of the loads; outside, up the dump, it is 1.75 per cent against. One 13- and one 15-ton Westinghouse locomotives work between the tipple and a sidetrack 8,600 ft. away in No. 2 mine. Passing tracks are provided every 4,000 ft. along the single-track main line. Cars, wood construction with 16-in. A.C.F.-Timken wheels, hold 3 tons mechanically loaded, and main-line trips run to a maximum of 50. Two 8-ton trolley locomotives relay both hand and mechanical coal to the sidetrack. Relay distances vary up to a mile. The haul is downgrade and trips of as many as 30 cars are handled.

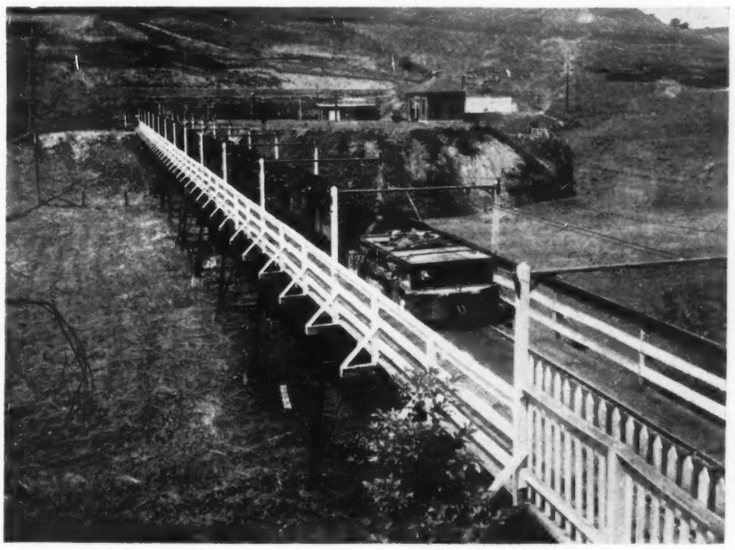
One tandem main-line unit (two 10-ton Jeffrey locomotives) handles main-line haulage at Pinnikinnick No. 25 mine, Consolidation Coal Co., Harrison County, where the output comes from one loading machine served by rubber-tired haulage units. Distance from the working section to the tipple, including the slope, is about 3 miles. Main-line trips comprise 35 cars each holding about 3 tons, and the tandem unit delivers 400 to 500 tons to the outside in seven hours.

Along with loading machines, the Glen Cambria mine, Mountain Fuel Co., Barbour County, installed 100 new Phillips steel-and-wood cars with a capacity of 5 tons and equipped with chilled Timken-bearing wheels. In addition, 120 3-ton wood cars with plain bearings still are in service. Hand loading still is done in some sections of the mine. No attempt is made, however, to restrict the new cars to the loading machines. Length of the main-line haul is 3 miles and the grade of about 3 per cent favors the loads. Cars are brought in trips of 25 to the top of an incline by a 10-ton Goodman locomotive.

Gathering locomotives in use at northern West Virginia mechanical mines are, with one exception, of the cable-reel type and usually vary in size from 5 to 8 tons. Details on types and sizes are given, with other information on gathering and car-changing methods, in the article beginning on p. 51. In most cases, the rated speed of gathering units is 6 to 6½ m.p.h., but at Continental No. 4 all gathering locomotives are being converted to 4 m.p.h. Actual test has shown that the slower-speed units will produce more coal, in addition to savings in damage to track, locomotive maintenance, sand, etc.

Three-quarters of the northern West Virginia mechanical mines use rail weights of 60 lb. or more on main lines and some carry 60-lb. steel to the entrances to the working sections. In fact, the general practice is to use about the same weight

A 15-ton locomotive pulling a 30-car trip across the steel bridge at Dawson No. 2.

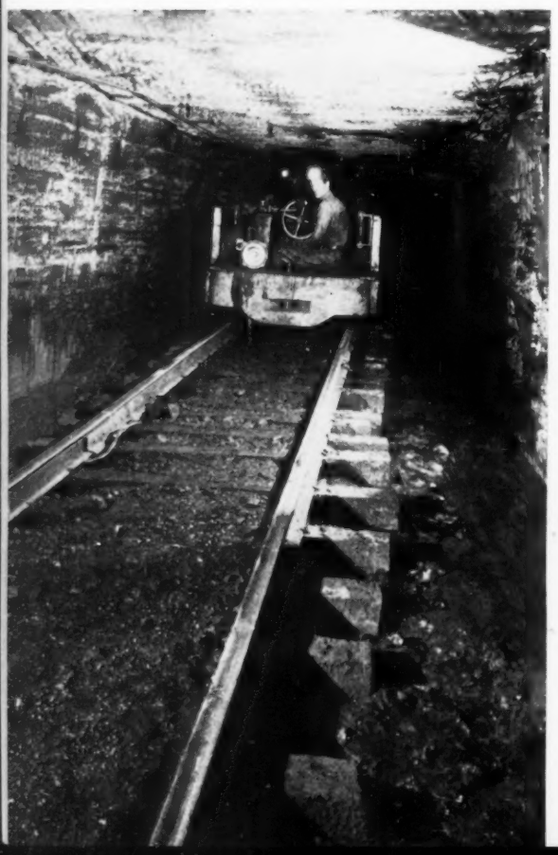


of steel on secondary routes as on main lines. Reconstruction of roads has and continues to be active, this rebuilding involving grading, drainage, welding of track, use of treated ties, etc., in addition to cutting length of hauls and heavier rail as outlined above. As an example, the Louise mine, which now has 50- and 40-lb. rail on main and secondary routes, plans to install 60-lb. material on the new cut-off route described earlier in this article. Continental No. 4 is another operation now using light steel (45-lb.) on main and secondary roads, but which plans 60-lb. on a new cut-off line, to be graded level, except for 1 per cent on one 1,000-ft. stretch, as compared with a maximum of 4 per cent on present lines.

Joints on nearly 14,000 ft. of main line have been brazed at the Pursglove No. 2 mine, where 1 ft. of bottom always is taken for height, with other grading as necessary to cut down hills. Rail size is 60-lb. On all new track with a life of five years or more, treated 4x6-in. ties on 2-ft. centers are used. These are supplemented by tierods of old 4x$\frac{3}{8}$-in. ear irons, which clip over the base of each rail to maintain gage and alignment. Welding of joints is the practice on all permanent track, and in this connection joints on 7,300 ft. of loaded track and 6,300 ft. of empty track were made with a manganese-bronze welding rod applied by an oxyacetylene torch. A small plate is used under each joint to stiffen the rail and facilitate welding.

Reconstruction of all main line with 60- and 80-lb. rail with welded joints, treated ties, etc., was a recent project at Pursglove No. 15 mine. At the time of the *Coal Age* survey, about three miles of a total of 4½ had been completed. Rebuilding naturally included grading. On 3,800 ft., in particular, the track was put on an adverse grade of 1 per cent, as compared to previous hills running up to 4 to 6 per cent. As a result, trip size was raised from 25 to 30 cars and two locomotives now handle the same tonnage as three before.

Haulage headings at Robinson Run No. 2 are top cut and sheared on both sides to reduce falls and sloughing. Track for the 15-ton haulage locomotives is 85-lb. rail on 5x7-in. ties.



Cresoted Ties Laid

Rebuilt track is laid with 5x7-in. creosoted ties on 2-ft. centers. In the future, however, it is planned to use not only ties but also timber and lagging treated by the Osmose process (October, 1939, *Coal Age,* p. 53). This applies to No. 2 mine also. Before reconstruction started at No. 15, however, an extensive investigation into methods of welding joints was carried out, including testing at the West Virginia University College of Engineering. As a result, steel arc-welding was adopted in connection with the use of a plate $\frac{3}{8}$ in. thick, 6 in. wide and 10 in. long under the joint, which tests showed to result in the strongest possible construction. In welding this plate to the base of the rails it was discovered that the bead should not approach the ends closer than ½ in.; otherwise, there is a possibility of a break. Rails are not veed out, etc., the making of a joint involving only application of the plate and filling of the gap between rails with rod.

Maximum cost of a joint made in the above manner is about $1.75, of which the cost of the plate is about 30c. and the cost of the rod (Fleetweld 7) another 30c. Bonds and angle bars naturally are eliminated and from the electrical standpoint the joint, because of the use of the plate, has less resistance than the rest of the rail. Cross bonding is done around switches by welding ½x4-in. sections from old drawbars, etc., across the two rails.

Nearly a mile of inside track from the portal to the relay sidetrack was relaid with 85-lb. steel on oak ties in the first half of 1939 at the Rosedale mine, where 60- and 70-lb. rail is used outside and 60- and 40-lb. on secondary routes inside. Partings, in all cases, are 60 lb. Inside roads are graded where necessary to cut the inclination down to 3 or 4 per cent or less, and ditches are dug along the rib to lead water off to sumps in side headings.

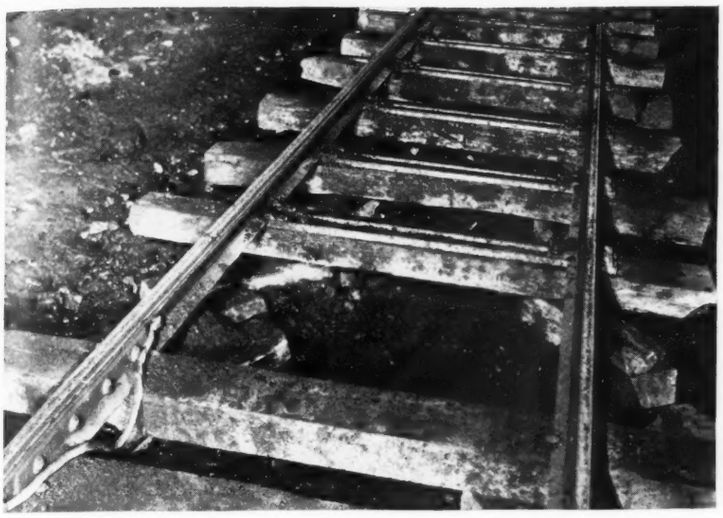
When Emily mine was reopened on March 1, 1935, about 1½ miles of the main haulage heading was cleaned up with a Whaley "Automat" loading machine. Heading width was approximately 12 ft. and the material removed averaged 4 ft. in depth. The entire main line was rebuilt with 60- to 85-lb. rail on sawed ties, as compared with 60- and 40-lb. rail on secondary roads. Several major drainage ditches were put in, including one tile ditch and another major drainway about 3½ ft. deep and 600 ft. long to a sump. Grading also was done where necessary, including filling one stretch about 1,000 ft. long to a depth of 5 to 6 ft., primarily to get the track up out of the water.

All haulage up to the working sections is laid with 85-lb. steel at the Robinson Run No. 2 mine, using 5x7-in. ties on 24-in. centers. All main-line routes are graded to less than 2½ per cent against the loads, while the average is 2 per cent. This latter was obtained through the old Harmar mine by raising the roadbed some 6 ft. Water is taken care of by ditches in the parallel headings leading to sumps.

Use 60-Lb. Rail

Main-line practice at Maiden mine involves the use of 60-lb. rail up to the passing sidetracks in the working sections. Creosoted ties (Wood Preserving Corporation) are used in all permanent track. In the past three years, grading has been done over the entire mine to eliminate stiff hills and thus reduce power peaks and increase trip size. Profiles were run to determine the best possible grades with the least cost and in some cases cut depth was as much as 4 ft. Pumping is relied upon to handle water along the haulways. As in the case of all other mines in the region, Maiden uses mine material for ballast but supplements it with refuse from the washer.

Sixty-pound rail on 5x7-in. Wood Preserving creosoted ties also is the practice at Federal Nos. 1 and 3 mines, while at Rachel mine all the original 40-lb. main-line steel has been replaced with 60- and 80-lb. material. Secondary routes are laid with 60-lb. rail up to the working sections. At the Jamison mines, one mile of 85-lb. track on 5x7-in. ties has been laid at No. 8. All other main lines and secondary roads at



A new section of 40-lb. track in Pinnikinnick No. 25 mine showing the use of steel ties bolted to wood for greater stability.

both operations are constructed with 60-lb. steel. At these mines, Portable Lamp & Equipment Co. transition rails are used when changing from the 60-lb. secondary track to the 40-lb. track laid in room entries. At Eagle mine, on the other hand, secondary routes are laid with 45-lb. rail, while the main lines consist of 60- and 80-lb. steel.

The coal at Dawson No. 2 mine is regular and little grading therefore is required. Main lines are laid with 70-lb. steel (all new work). In this process, 8 in. of fireclay is taken up and an 8-in. subgrade of hard material is built, on which the 5x7-in. ties are laid. Mine material is used for ballast. Ditches are dug in the parallel place, which also is the manway, to drain the haulage road by means of laterals.

Main-line track at the Pinnikinnick No. 25 mine conforms to the company's Class A specifications, which include 60-lb. rail and 5x7 creosoted ties (8 lb. of creosoted oil per cubic foot of timber). Installation of creosoted ties was started about 1927, and to date the removals for rot have been extremely few.

Largely as a result of the practice, in Pittsbugh-seam mines, of leaving top coal, roof support along main haulways usually is not necessary or is required only at certain spots. Generally, wooden legs and crossbars are employed on such occasions, although other types of supports are used at some mines. Continental No. 4, for example, installs some steel H-beams. And the Pursglove No. 15 haulway, in certain sections, is protected by 8-in. I-beams on reinforced concrete piers on 4-ft. centers. Treated 3x12-in. plank is used as lagging. Such lagging and all other permanent wood timbering will, like ties, be Osmose-treated in the future.

Six-inch H-beams on creosoted legs now are standard for permanent roof support at Maiden mine, while Mona has installed steel and wood bars on wooden legs and concrete-block piers. The same is true at the Jamison mines. From now on, at Dawson No. 2, the standard is steel-rail crossbars. And until recently, 6x6-in. H-beams with 3-in. creosoted plank for lagging were used at Pinnikinnick No. 25. Now, the practice is to install a 6½x8 CB section, still with creosoted plank. Steel rails are used at the Federal mines and usually were put on legs. Recently, however, the management has begun experiments with hitch holes made by using a large-diameter auger on a regular coal drill mounted on a locomotive, the idea being to get rid of legs which may be knocked out and are subject to decay.

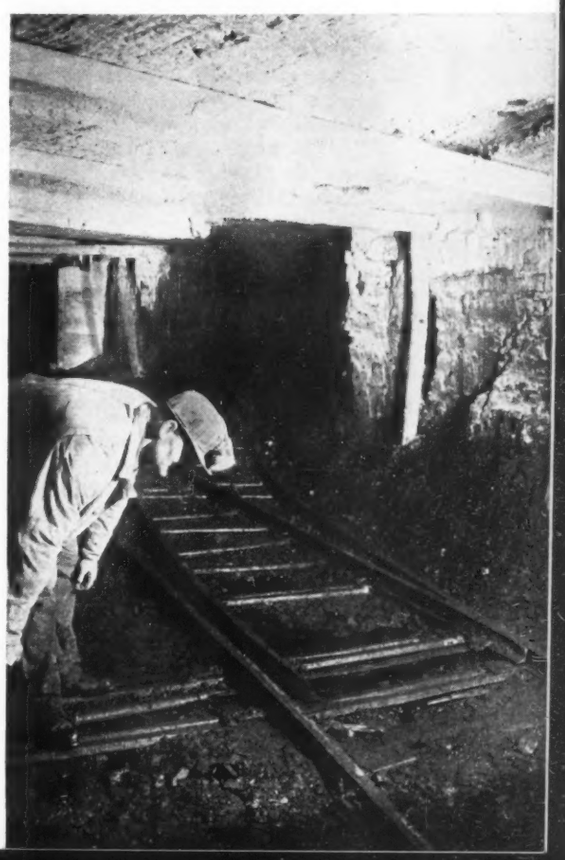
Top-cutting to keep powder away from the top and thus prevent cracking it has been adopted by a number of producers, as at Jamison where haulage headings frequently are both top and bottom cut and sheared. This process is carried still farther, however, at the Robinson Run No. 2 mine, where all haulage headings are sheared on both sides in addition to top cutting. The result is the soundest possible top and a straight rib which is much less likely to slough.

Operations in working territories at northern West Virginia mechanical mines have been marked by a decided tendency toward the use of rail weights of 30 and 40 lb., supplemented by steel ties, usually from the standpoint of faster track-laying but also, in a number of mines, for additional height over the rear conveyor. As an example of both these trends, the Louise mine now is using 30-lb. rail instead of 20-lb. on butt entries and in rooms, and, while wood ties are standard, has gone to the practice of laying Bethlehem steel ties for a rail length or two behind the face for height. The same practice is followed at Emily mine, one of a large number which have gone to 40-lb. rail.

Laying all room track with steel ties and using steel-tie switches has been adopted, for example, at the Maiden mine (Bethlehem ties and switches, 30-lb. rail); Robinson Run No. 2 and Jamison Nos. 8 and 9 (also Bethlehem, 40-lb. rail); and Eagle mine (West Virginia steel ties and steel-tie switches, 30-lb. rail). At other mines, steel has been extended even farther, Mona and Dawson No. 2, as cases in point, laying all room entry track, in addition to the track in the working places, with Bethlehem and West Virginia steel ties and steel-tie switches. Both mines have gone to 40-lb. rail.

To serve the shuttle-car section at Pinnikinnick No. 25, the Consolidation Coal Co. uses 40-lb. rail laid on combination ties. In other words, the ties consist of an ordinary Bethlehem No. 3 steel tie bolted to a wood tie, thus gaining the strength and stability of the wood tie with the convenience and quicker laying and taking up of the steel tie. Bethlehem parallel-throw stands are used on all switches.

Steel ties and steel-tie switches are used on room entries as well as in rooms at Mona mine.



COAL PREPARATION

+ At Northern West Virginia Mechanical Mines

PREPARATION of coal at mechanized mines in the Fairmont field of northern West Virginia, as elsewhere, has been characterized by many changes and improvements in late years either to better the product or extend the range of sizes. While many of these changes antedated loading machines underground, others accompanied their installation —usually to take care of the added burden thrown on the surface works by expanding picking facilities or installing mechanical cleaners.

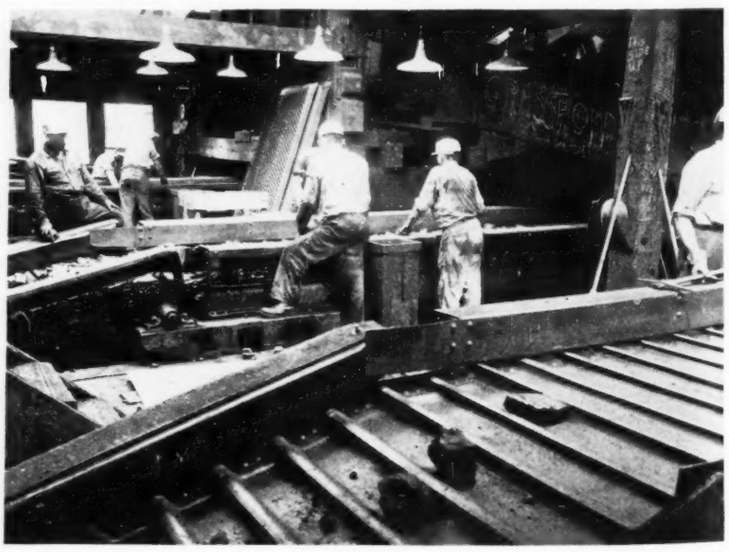
Mechanical loading, however, has not always meant a greater task for the preparation force. Instead of one shift, mechanized mines normally work two and sometimes three shifts a day, meaning that for the same daily tonnage the output per shift is greatly reduced. Where a plant originally was designed for one-shift operation, multiple shifting makes it possible to slow it down and, in fact, stop it when necessary to take care of an increase in impurities. As a rule, operators have found that by care underground to keep out of the bottom, gob, etc., and slowing down or stopping the plant or, where necessary, expansion of picking equipment or the employment of extra labor, or both, they still can ship a product meeting present-day standards. In a few cases, however, the impurity problem has been such, either by reason of volume or irregularity, as to require mechanical cleaning.

Aside from cleaning, changes at hand-picking and screening plants have been largely directed to shipping an extra size, sizes, or combinations of sizes. The former normally is accomplished by additional screens to separate slack into pea or stoker and still smaller slack. Frequently, such rescreening is accompanied by a storage bin or bins to permit loading two sizes on one track, inasmuch as cost or physical conditions usually prohibit building additional loading tracks. The trend toward combinations, another reflection of changing sizing considerations, has resulted in installation of a number of mixing conveyors, while the widespread employment of crushers, either for one or all prepared sizes, marks a decline in large coal. At some plants, in fact, lump seldom, if ever, is shipped.

Auxiliary steps to increase consumer satisfaction take several forms, such as tramp-iron magnets, particularly for smaller sizes, dustless treatment by hot or cold oil or calcium chloride, increased use of degradation screens, etc. Special truck-loading plants have been installed by some companies to take care of local markets. And to add to efficiency, promote cleanliness and reduce hazards, dust allaying by chemicals has been adopted.

Lump, egg, nut and slack, or lump, egg and slack are the usual primary sizes at northern West Virginia plants. By rescreening slack, several companies add pea or stoker to their list. The two or three largest sizes normally are hand-picked at plants not equipped with mechanical cleaners and loaded over booms. At the Katherine mine, Katherine Coal Mining Co., Harrison County, for example, mine-run usually is divided into plus 4-, 4x2-,

The most used cleaning method in northern West Virginia—hand pickers at work in the Mona tipple.



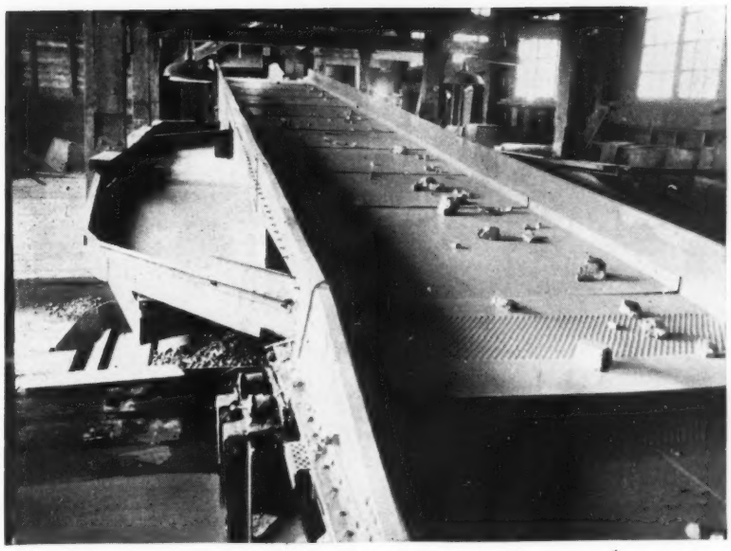
2x¾- and minus ¾-in. sizes on a shaker screen. The two large sizes are hand-picked on tables ahead of loading booms. The 2x¾-in., after passing over a chute-type magnet to remove tramp iron, may be loaded separately, in combination with the lump or egg, or both, or in combination with the minus ¾-in. With three loading tracks, a maximum of three sizes may be loaded at one time.

The neighboring Laura Lee mine of the Hutchinson Coal Co. normally separates mine-run into 4-in. lump, 4x1¼-in. egg, 1¼x¾-in. nut and ¾-in. slack. Lump, egg and nut are hand-picked, and lump and egg are boom-loaded. A cross conveyor is provided for mixing any of the four major sizes, while a Helmick high-speed shaking screen removes degradation from the nut, this degradation going into the slack, which may either be minus ¾-in. or minus 1¼-in. (1¼x¾ and minus ¾ combined). At the Pinnikinnick No. 25 tipple of the Consolidation Coal Co., also in Harrison County, shaker screens and picking table-loading booms for lump, egg and nut, with chute loading for slack, are supplemented by a McLanahan & Stone crusher for breaking down mine-run or lump when market conditions make it desirable.

Modern Units Installed

Several auxiliaries are included in the Federal No. 3 tipple, Koppers Coal Co., Monongalia County. Built by Roberts & Schaefer and equipped with a Marcus screen and picking table for making lump, egg, nut and slack and two loading booms, the No. 3 plant includes a Jeffrey 36x36 single-roll crusher for breaking down lump and other coarse sizes, a 60-in. suspended-type E. C. & M. magnet for catching tramp iron and a "Brownie" layer-loading hoist. Light for picking is supplied by 400-watt General Electric high-intensity mercury-vapor lamps. The crusher is mounted in a frame suspended from a bridge crane at the end of the lump boom. Thus, it is possible to raise the boom, roll the crusher under the boom end and discharge the broken coal directly into the car. The layer-loading hoist permits pulling a car back and forth during loading to prevent concentration of either sizes or impurities in one spot.

A distinctly different preliminary breaking and hand-picking unit, developed by Frank E. Christopher and other officials of the Christopher Mining Co., is installed at the Robinson Run No. 2 mine, in Monongalia County. New in 1938, the Robinson Run preparation plant consists of two parts, the breaking and picking structure and a railroad screening and loading plant. The two are connected by a 36-in.-wide belt conveyor 600 ft. long set on a slope of 11 deg. A 7-ft.-wide 47-ft.-long shaker screen in the railroad plant separates the coal into lump, egg and slack. Lump and egg are loaded over apron-type booms. For high efficiency in separation with a minimum of degradation, the screen is set on a pitch of 3 in. per foot and is driven at 140 5-in. strokes per minute. More complete elimination of wet fines from coarse coal is assured by a slack-screening area of 215 sq.ft.



Lower end of the 167-ft.-long picking, sizing and distributing unit in Emily tipple.

All sizes or combinations of sizes made in the tipple may be sent to a barge-loading dock on the Monongahela River by a supplementary 400-ft.-long conveyor, which discharges into a surge bin. A 70-ft. loading belt carries the coal from this bin to a special chute designed for uniform loading of 850-ton barges at any river stage except flood.

Coal from Robinson Run No. 2 is dumped into a 200-ton steel bin. An auxiliary bin at one end of the coal bin holds about six cars of mine rock, which is fed into trucks for disposal. Mine-run from the bin is fed into a multiple-deck screening and picking unit (Fig. 1) operated by a Marcus drive. Screen sections at the upper end separate the feed into plus 3-, 3x2-, 2x1¼- and minus 1¼-in. sizes. The plus 3-in. coal travels off the screen onto a picking section and from there into a McNally-Norton vertical-pick breaker. Broken coal flows onto a second picking section and then drops through a chute to the lower deck, where all sizes, as indicated in Fig. 1, are recombined for discharge onto the belt conveyor to the railroad plant. The 3x2- and 2x1¼-in. sizes made on the screens each flow on separate decks under the breaker to picking sections made by stepping off the lower end of the unit. After picking, each size goes to the bottom deck, as outlined above. Pickings are dropped through chutes to a trough below the lower deck and are shaken down to a conveyor leading up to a bin, from which the pickings are hauled away by truck. Light for picking is provided by Westinghouse high-intensity mercury-vapor lamps.

Mechanized mines which have installed auxiliary screening equipment, usually of the vibratory type, for making nut, stoker or pea from slack are in the majority in northern West Virginia. For instance, at the Eagle mine, Getty Coal Co., in Harrison County, where the coal is fed out of a 200-ton bin onto a shaker screen for separation into lump, egg and slack, a Symons horizontal vibrator has been installed under the shaker to further separate slack into nut (apron-type boom) and small slack. Lump and egg are picked and loaded over two additional apron-type picking table-loading booms.

A crusher supplements the vibrator in the rebuilt Morrow tipple serving the Bunker mine, Davis-Wilson Coal Co., Monongalia County. With five loading tracks, this plant includes a shaker screen making—usually—5-in. lump, 5x2-in. egg, 2x1¼-in. nut and 1¼-in. screenings. As lump seldom is shipped, it gen-

Lower end of the breaking and picking unit at Robinson Run No. 2 mine showing, behind the three mercury lights, the pick breaker.

erally is run to a 24x24 McLanahan & Stone crusher for reduction and recirculation to the main screen. Slack may be run to an Arms vibrator for making 1¼x¾-in. stoker, ¾x⅜-in. pea and ⅜-in. slack. Lump (if made), egg and nut are hand-picked and boom-loaded; a mixing conveyor makes possible any desired combinations, including a mine-run comprising hand-picked and recombined individual sizes.

A 30x30 McLanahan & Stone single-roll lump crusher also is installed in the five-track Louise Coal Co. tipple, another Monongalia County operation. Coal comes into this tipple via a crossover dump in the top but it is planned, in connection with haulage revisions, to build an 800-ton storage bin, from which mine-run will be fed by a belt conveyor onto the main shaker, now set to make 4x2- or 5x2-in. egg, 2x1¼-in. nut and 1¼-in. slack. Lump can be crushed to 4 or 5 in. or less and recirculated to the screen. The 1¼-in. slack can be dropped onto a 4x10-ft. Tyler-Niagara vibrator under the main shaker for making 1¼x¾-in. stoker, ¾x⅜-in. pea and ⅜-in. slack or various other combinations of sizes.

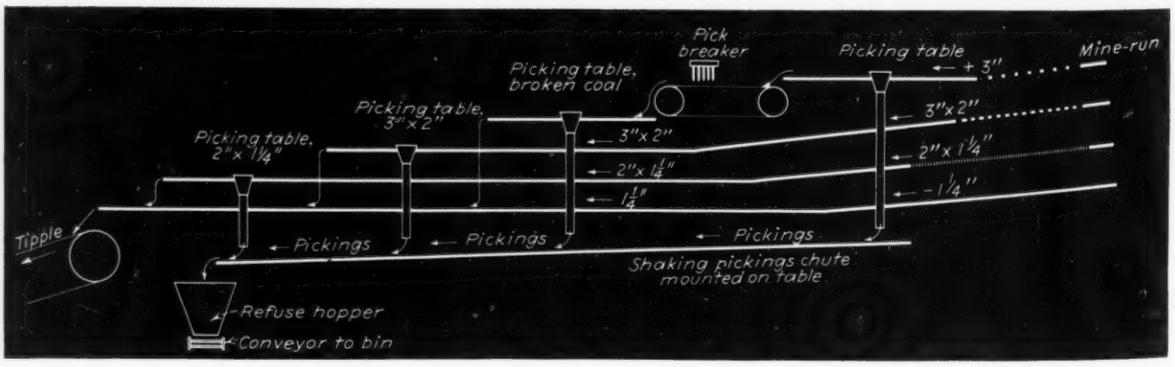
Complete tipple rebuilding by Roberts & Schaefer marked the reopening of Emily (formerly Eureka) mine, Monongalia County, by the Monongahela Rail & River Coal Corporation. This involved installation of a Marcus screening and picking unit 167 ft. long, a McNally-Norton vertical-pick breaker, two loading booms, vibrating screen for rescreening slack to make pea and small slack, which are loaded directly, slate-disposal conveyors and other facilities. Sizes produced usually are egg, nut and slack, inasmuch as little lump is shipped. But if lump is made, egg is eliminated from the schedule.

The Marcus unit is stepped about one-third of the way down, and the upper end is used for the major part of the picking, with the vertical pick breaker at the step for breaking down lump, or lump and other coarse coal if desired, discharging onto the lower section for supplementary screening and picking. The lower section also distributes the various sizes to their respective booms, chutes, vibrators, etc. Mixtures are made on the unit also. A chute-type magnet removes tramp iron from the minus 2-in. size.

Chemical dust allaying, shaking and vibrating degradation screens, chute and suspended magnets, vertical-pick breaking, mercury lights, vibrating rescreens, mixing-conveyor equipment and cold-oil dustless treatment distinguish the Federal No. 1 plant, Koppers Coal Co., in Marion County. As the coal leaves the weigh basket it is sprayed by a solution of 1 gal. of "Sealtite" (Midland Chemical Co., Cleveland, Ohio) in 100 gal. of water, which has been found very effective in eliminating dust in the tipple at small expense. A shaker screen separates the coal into lump, egg, nut and slack, the three large sizes going onto the picking tables ahead of apron-type loading booms. Before they go onto the booms, degradation is removed from lump and egg by high-speed shaking screens; from nut by a "Hum-mer" vibrator. All degradation is recirculated to the main screen. Mercury lights are installed for picking and a McNally-Norton vertical pick breaker is used for reducing lump when desired. This breaker discharges onto the egg degradation screen, which takes out the fines for recirculation and rescreening.

Slack can be loaded directly at Federal No. 1 or can be run over three Tyler 400 electric screens to make stoker and slack. A 60-in. Cutler-Hammer suspended magnet and three Central Electric Repair chute-type units remove tramp iron from minus 2-in. coal. Either or both stoker and slack may be loaded

Fig. 1—Diagrammatic elevation of breaking and picking unit at the Robinson Run No. 2 mine.



separately or returned to the main mixing conveyor for combination with other sizes. "Brownie" high-pressure equipment is installed for spraying all sizes with cold oil.

Five loading tracks are provided at the Jamison No. 9 plant, Jamison Coal & Coke Co., Marion County, where a shaker screen separates mine-run into lump, egg, nut and slack. Slack may be diverted to a Ricks vibrator under the shaker for separation into pea and slack. Lump and egg, after hand-picking, are loaded over apron-type booms. Belt booms are provided for nut and pea. A mixing conveyor is provided for making combinations, and this conveyor is arranged to discharge any or all sizes placed in it into a McLanahan & Stone crusher. The crushed product may be returned to the mixing conveyor, which is equipped with adjustable-length chutes for loading, or to the main screen for resizing. A chute-type magnet built into the shaker screen removes tramp iron from the minus 2-in. size. The hot-oil system of dustless treatment is installed.

Plants which have installed a storage bin to permit making and loading an extra size include the Mountain Fuel Co., Glen Cambria mine, Barbour County. At this operation, equipped with a mixing conveyor for combinations and picking tables and loading booms for lump and egg, mine-run is separated into lump, egg, nut and slack on a shaker screen. A Ricks vibrator rescreens slack to make pea and slack and the slack is conveyed to a storage bin a sufficient distance above the tipple to permit loading two cars on one track.

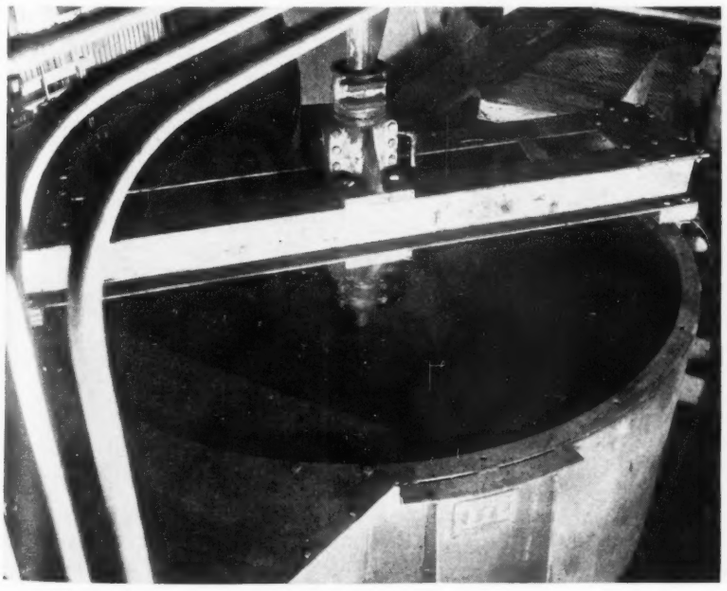
Rachel surface works, with the tipple at the right and the truck-loading bins at the left.

A 100-ton storage bin was installed at the Jamison No. 8 plant, Marion County, in a Robins rebuilding job to provide for rescreening, crushing, etc. A shaker screen separates mine-run into lump, egg, nut and slack, the three large sizes going to the picking sections of apron-type picking table-loading booms. Slack may be loaded directly through a chute or bypassed to a belt conveyor to a 6x12-ft. Robins "Gyrex" vibrator for separation into pea and slack. A suspended magnet over the belt removes tramp iron. Pea from the vibrator is loaded directly, while slack is conveyed to a 100-ton steel storage bin below the tipple, which makes possible loading two cars on one track, thus providing five loading points even though only four loading tracks are available.

A mixing conveyor at the ends of the booms can take any or all sizes from these booms in raised position for making combinations and reassembled mine-run. Pea and slack from the vibrator may be run into this mixing conveyor, which is arranged to discharge into a belt conveyor to a 36x36 McLanahan & Stone single-roll crusher. Broken coal is conveyed to a second Gyrex vibrator which takes out the nut. Slack through the screen is conveyed back to first "Gyrex" unit. Under the Jamison No. 8 arrangement, it is possible to break the entire output to nut or smaller and rescreen if desired. Egg, pea and slack may be treated with hot oil.

Storage bins directly loaded by belt conveyor for truck loading supplement the railroad tipple at the Rachel mine, Jones Collieries, Inc., Marion County. This plant, which was designed and installed under the supervision of the Jones Collieries engineering department, went into service in 1936. Equipment in the railroad tipple includes a Parrish-type shaker screen to separate the mine product into three or four sizes, depending upon whether or not the rescreening plant is being operated. Without rescreening, lump, egg and slack are the primary products. With rescreening, lump, egg, nut and slack are made, the latter going to the rescreener. Lump and egg are picked on the table sections of picking table-loading booms

Part of the washing cone and the dewatering, desanding and sizing screen, Pursglove No. 2 preparation plant.



This mechanical plant at Pursglove No. 2 mine washes Sewickley coal.

Pursglove No. 15 washing and sizing plant handles Pittsburgh-seam coal.

and the shaker screen is equipped with slide gates for making mixtures up to and including reassembled mine-run. A special chute permits dumping mine-run directly to the railroad cars on No. 3 track next the shaft. An aerial tramway (Interstate drive, Broderick & Bascom buckets and Macwhyte cables) now is being installed to handle mine and tipple refuse and permit reclamation of coal suitable for certain trade uses.

When rescreening, slack from the shaker falls into a Redler conveyor-elevator which carries it up-track and lifts it to the top of the rescreener, discharging it onto a 6x10-ft. double-deck La-Del vibrator. Stoker nut is made on the two screening decks and goes over a Central Electric Repair magnet into a 75-ton bin over No. 2 loading track; slack through the bottom deck falls into a second 75-ton bin over No. 3 track. Thus, with the two bins, it is possible to load five sizes on three tracks.

The Rachel domestic-coal plant comprises four 25-ton bins with a fifth smaller bin for utility use. Coal for the domestic plant is taken off the side of the main shaker in the railroad tipple by means of slide gates and side-discharge chutes. Treatment for dustproofing is based on the use of oil.

Another new plant serves the Dawson No. 2 mine, Dawson Coal Co., Harrison County. Built by Fairmont in 1935 and designed to permit the future installation of washing equipment, the Dawson plant includes a vibrator for rescreening slack, crushing equipment, mixing conveyor, tramp-iron magnet and oil treating. Coal is fed onto the main shaker by a belt, which can receive mine-run directly from the feeder. The mine-run, however, can be bypassed to an adjustable-opening bar screen. Material over the bars goes into a 42x30 McLanahan & Stone crusher (450 tons-per-hour capacity) for reduction as desired. The crushed product joins the fines through the bar screen on the belt feeding the main shaker.

A Central Electric Repair magnet is installed in the chute which carries the coal off the belt to the shaker. The shaker separates the coal into lump, egg and slack, the lump and egg going over degradation screens onto picking tables followed by loading booms. Slack off the main screen is discharged onto a 4x16-ft. Symons horizontal vibrator, which also receives lump and egg degradation. The vibrator separates the feed into stoker and slack, which may be recombined for loading or the stoker loaded and the slack conveyed by belt to an up-track storage bin. This bin naturally permits loading four sizes at a time with three loading tracks. A mixing conveyor is installed at the ends of the picking tables for making combinations. A "Brownie" spraying system permits cold-oil treating of all sizes.

Tipple Modernized

Rebuilding the Rosedale tipple, Rosedale Coal Co., Monongalia County, was another 1935 project. In this rebuilding, by Fairmont, a new main shaker was installed, along with two picking tables and booms, a rescreening plant for slack, etc. Sizes normally shipped are 4x2-in. egg, 2x1-in. nut and 1-in. slack or 1x$\frac{3}{8}$-in. pea and $\frac{3}{8}$-in. slack made by rescreening the minus 1-in. product. Lump and egg made on the main screen are hand-picked and loaded over belt booms, with a chute for 1-in. slack. The latter size, however, may be bypassed to a belt leading to the rescreening plant up the track, where a 5x12-ft. "Gyrex" vibrator fitted with "Ty-Rod" cloth separates it into pea and small slack. Pea goes by Fairmont spiral lowering chute into one 80-ton bin and slack into another. From the bins, the two sizes may be loaded on either or both of two tracks, giving in effect five loading points with three loading tracks. By bypassing the vibrator and using only one bin, 1-in. slack also may be loaded from the rescreening plant.

Rebuilding of the Mona plant, Arkwright Coal Co., Monongalia County, another Fairmont job, was started in 1929, with wholesale revisions in 1935. A crusher for breaking lump was installed in 1929 in view of the declining importance of this size, and in that year the plant included a shaker screen, two loading booms, slack-storage bin with loading chutes and a truck-loading plant for domestic sales. In 1935, the crusher was relocated under the discharge end of the rope-and-button conveyor feeding the plant. With this arrangement, mine-run may be run onto the main shaker screen or bypassed to a bar screen to remove fines, the oversize going into the crusher. Crushed product and fines then are elevated to the main screen for sizing.

A new shaker and a third loading boom were installed in 1935. The original booms were lengthened to provide picking sections and a reversible mixing conveyor, as well as auxiliary belt conveyors to permit running slack around to the truck-loading plant via the mixing conveyor, were added. A third loading track was put in, along with vibrating screens for making pea and a pea bin alongside the slack bin.

New refuse conveyors were another addition.

Operating on mine-run without crushing, the main screen now separates the feed into lump, egg, nut and slack. The three large sizes are hand-picked and loaded over apron-type booms, which may be raised to discharge into the mixing conveyor. Slack from the main screen may be brought by belt to the mixing conveyor for making combinations, or the mixing conveyor may carry it to another belt feeding onto the conveyor to the truck-loading plant. Normally, however, slack is conveyed down track to the resereening plant, where two Fairmont vibrators separate it into pea and small slack, the former going into the new bin, which is equipped with a Robert Holmes spiral lowering chute. Small slack goes into the second bin, which also, by bypassing the vibrators, may be used for loading large slack. The bins are arranged to discharge to either one of two tracks, and with this arrangement five sizes may be loaded on three loading tracks.

Bins Serve Trucks

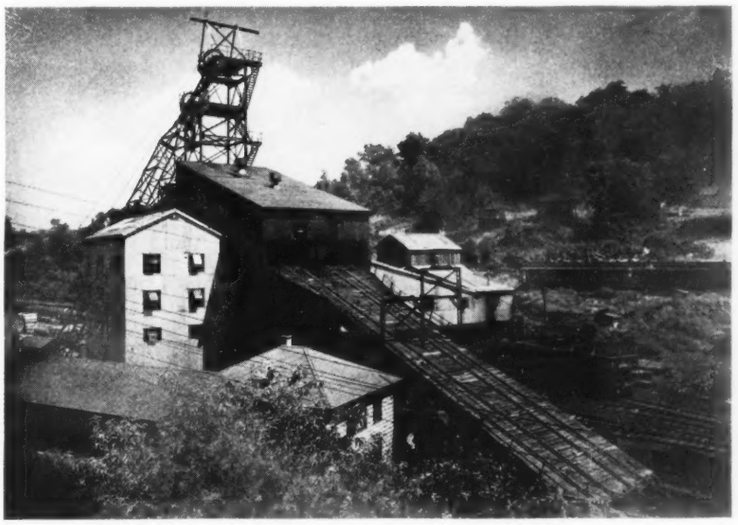
The truck-loading plant at Mona comprises three storage bins usually accommodating lump, egg and slack. Sizes are brought to the plant one at a time and degradation screens remove breakage. A fourth bin alongside the other three is used for refuse, which is hauled away by truck. All sizes from the truck-loading plant may be dustproofed with calcium chloride. Mona mine also ships coal in barges, using jointly with the Pursglove Coal Mining Co. and others a simple platform dock on the Monongahela River. The coal is brought to the dock in trucks, which back out to the edge and dump directly through a chute into the barge.

Two of the four mechanical-cleaning plants installed in northern West Virginia beginning in 1937 serve Sewickley-seam mines, while two more clean coal from Pittsburgh-seam mines. All four plants are in Monongalia county and in all the practice is to bypass fine slack (around $\frac{3}{8}$- to $\frac{1}{2}$-in.) around the washers. Lump (plus $4\frac{1}{2}$-, 5- or 6-in.) normally is hand-picked. Thus, washing equipment usually handles coal from $\frac{3}{8}$ or $\frac{1}{2}$ in. up to $4\frac{1}{2}$ to 6 in.

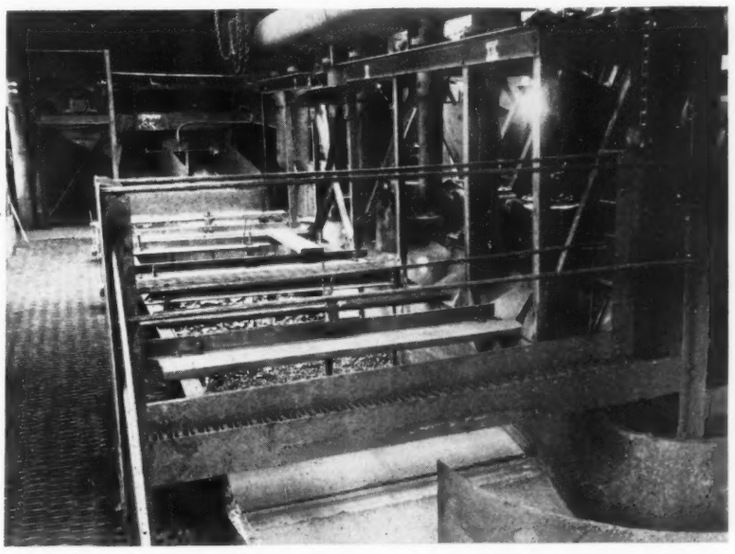
The first of two Pursglove Coal Mining Co. washing plants began work at the No. 2 mine, Sewickley seam, in September, 1937. The No. 15 plant, cleaning Pittsburgh-seam coal, started August, 1938. Reject at both plants runs around 8 per cent, and the major objective in their installation, in addition to reducing impurity content, was to insure maximum uniformity of shipments. Sink in the washed pea size ($1\frac{1}{4}$x$\frac{3}{8}$-in.), when tested at 1.40, averages less than 1 per cent; also true of the float in the refuse at the same gravity.

Sewickley coal at No. 2, built by United Engineers & Constructors, Inc., is discharged onto a Marcus screen, which also serves as distributing conveyor for coal and refuse and as a mixing unit. On this shaker, the mine-run is separated into plus $4\frac{1}{2}$-in., $4\frac{1}{2}$x$1\frac{1}{4}$- and minus $1\frac{1}{4}$-in. sizes. Lump is picked on the Marcus unit and is discharged to a steel-apron loading boom, although it can be bypassed to a 30x30 single-roll Jeffrey crusher for reduction and recirculation. Other sizes also may be run to this crushing unit.

Minus $1\frac{1}{4}$-in. coal from the Marcus shaker is discharged onto a 5x16-ft. two-deck "Gyrex" vibrator, where it is separated into $1\frac{1}{4}$x$\frac{3}{8}$- and minus $\frac{3}{8}$-in. sizes. The $\frac{3}{8}$-in. slack may be loaded by itself, returned to the main shaker for mixing or run to a belt conveyor leading to a storage bin up-track from the plant, which makes possible loading at an extra point to give five loading points (lump, egg, nut, pea and slack) with four loading tracks. The 4x$1\frac{1}{4}$-in. coal from the main shaker is combined with the $1\frac{1}{4}$x$\frac{3}{8}$-in. coal from the



The washing and screening additions to the Continental No. 4 plant appear at the right and left of the mine-car trestle.



Preceded by tramp-iron magnets under the launders, this washing unit at Continental No. 4 cleans Sewickley coal.

vibrator and conveyed to a 10-ft. Chance cone for washing. Cone capacity is 200 tons per hour and, when crushing, the top size of the feed may run up to 6 or 8 in. Washed coal is sized, desanded and dewatered on a shaker screen following the cone and the various sizes then go to the Marcus unit for distribution or mixing. Refuse from the cone goes to another section of this screen for dewatering and desanding and conveyance to the refuse bin. The Marcus unit also delivers any size or mixture of sizes to a house-coal bin via a belt conveyor.

From the equipment and capacity standpoint, the Pursglove No. 15 plant, producing the same number of sizes, is generally similar to the No. 2 plant. The major exceptions are replacement of the Marcus screen and vibrator in No. 2 plant with a conventional shaker screen in No. 15. And in No. 15 a separate vibrator is employed for desanding and dewatering refuse. Mine-run at No. 15, built by Fairmont, is discharged onto a shaker screen 7 ft. wide and 45 ft. long (two sections operating opposed at 155 r.p.m., 5-in. stroke). This screen separates the feed into plus 5-, 5x$\frac{3}{8}$- and minus $\frac{3}{8}$-in. sizes. The 5-in. lump goes onto the picking section of an apron-type picking table-loading boom, while the minus $\frac{3}{8}$-in. size normally is conveyed by belt to a storage bin down-track from the plant. This bin is high enough to permit loading on any one of three tracks and makes possible five loading points with four loading tracks. In making a reassembled mine-run or other combination on the lump boom, the minus $\frac{3}{8}$-in. coal may be run directly from the screen to that boom.

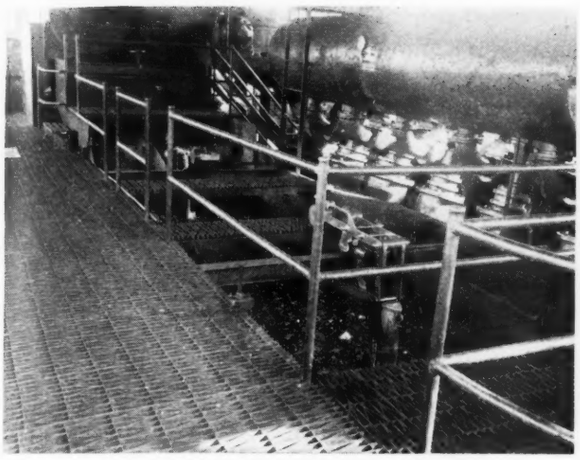
The 5x$\frac{3}{8}$-in. size at No. 15 is cleaned in a 10-ft. Chance cone with a rated capacity of 200 tons per hour. Over-all plant capacity is 300 tons per hour. Washed coal, with about 2,000 g.p.m. of water-sand mixture, flows over a stationary screen to remove part of the sand and water and then onto a two-section dewatering, desanding and sizing shaker of the Parrish type. Screen pitch is 7½ deg. and the speed is 145 r.p.m., 5-in. stroke. This screen separates the coal into 5x2-, 2x1¼- and minus 1¼-in. (nominally 1¼x$\frac{3}{8}$-in.) sizes, with final dewatering and desanding of the latter on 175 sq.ft. of Hendricks stainless-steel Perisertread screen, supplemented by 36 sq.ft. of additional screening surface in an auxiliary shaking chute. The 5x2-in. egg goes to a loading boom and the 2x1¼-in. nut and 1¼x$\frac{3}{8}$-in. pea to chutes. Pea, or nut and pea, however, may be run to the conveyor leading to the slack bin for making 1¼x0- or 2x0-in. slack, or can be combined with one or more or all of the other sizes in making combinations up to mine-run.

Refuse from the cone is discharged onto a 42x62-in. two-deck "Gyrex" screen for desanding and dewatering. Sand and water through the bottom deck (1/16-in. mesh) flow into a sump, which also receives sand and water from the coal screen. Overflow from the sump (about two-thirds of the circulating water), which is practically free of sand, is forced back to the cone by a 10-in. Morris centrifugal pump. Sand and the rest of the water from the bottom of the sump are returned to the cone by a Goyne sand pump. Make-up sand, running 0.2 to 0.3 lb. per ton of coal washed, is added to the sump as necessary.

Prevention of variations in the shipped product also was a major objective in a Jeffrey washing and screening plant at Continental No. 4 mine, Continental Coal Co. (Sewickley seam). Reject at this operation is around 8 per cent. Mine-run is dumped into a bin holding about 175 tons, from which it is fed onto shaker screens separating it into plus 5-, 5x$\frac{5}{8}$- and minus $\frac{5}{8}$-in. sizes. Lump is passed over a picking table to a loading boom or can be run to a 36x36 Jeffrey single-roll crusher for reduction to minus 5 or 4 in. and recirculation to the main shaker. Minus $\frac{5}{8}$-in. coal is conveyed to four 4x8-ft. Fairmont vibrators and separated into $\frac{5}{8}$x$\frac{3}{8}$- and minus $\frac{3}{8}$-in. fractions. The latter is combined with the fines recovered from the wash water and the combination is used in making various sizes of screenings or in mixtures of other sizes.

The feed to the washery, on the above basis, consists of a mixture of 5x$\frac{5}{8}$- and $\frac{5}{8}$x$\frac{3}{8}$-in. sizes, which enter the wash box through two launders. Practice at Continental No. 4 is unusual in that chute-type magnets for catching tramp iron are installed ahead of the wash boxes, with the further unusual feature that they

Modernistic preparation plant serving the Maiden mine, with the new barge-loading station out front. The slack and pea storage and loading bins are at the right of the main plant.



Maiden coal is cleaned in this five-cell air-operated jig, which also re-treats crushed middlings and bony pickings.

Close-up of Maiden barge-loading plant, showing loading boom and hoist which moves back and forth on crane track.

are under the launders and act through the bottom plates. Washing is done in a Jeffrey three-compartment Baum-type jig, and the washed coal is dewatered and sized on a shaker screen which also acts as the mixing unit and as a means of distributing the various sizes and combinations. Three loading booms are used. Refuse from both elevators on the washer is discharged to a bin and trucked away. Water and fine coal off the dewatering and classifying screen flow to a settling tank, from which the sludge is withdrawn for combination with the fine slack as detailed above. Clarified water from the settling tank is recirculated to the washer by a 6,000-g.p.m. Allis-Chalmers centrifugal pump.

The production of a large volume of mechanically loaded coal requiring uniform cleaning and preparation was the major reason behind the new plant at the Maiden mine of the Kelleys Creek Colliery Co., which handles Pittsburgh-seam coal. The new plant, designed and built by McNally-Pittsburg, went into operation in 1938 and is featured by steel and concrete construction and the squared forms, flat roofs and long rows of windows characteristic of the "modernistic" type of construction. Over-all capacity is 355 tons per hour; washing capacity, 250 tons per hour. Primary sizes are lump, egg, nut, pea and slack.

Construction of a new rotary-dumping installation was a supplementary project. This dump discharges the coal into a 2-car surge bin where, by means of five nozzles directed across the bin top, it is sprayed with "Sealtite" solution to allay dust. From the surge bin an apron-type feeder moves the coal onto a shaker screen which separates it into lump, small slack and an intermediate fraction (6 or 5x$\frac{3}{8}$ in.), which is discharged onto the washer-feed conveyor. Fines from the raw-coal shaker may be used in combinations or instead may be conveyed 100 ft. uptrack to a hopper designed to load on the No. 3 or 4 track.

Picking at Maiden yields two products: pure rock and coal intermixed with bony, etc. The former goes directly to the refuse bin, while the latter is elevated to a McNally-Pittsburg single-roll crusher for reduction to approximately 2 in. The crusher product goes to the washer-feed belt. Picked lump goes to an apron-type loading boom, which can be raised to discharge into a cross conveyor, from which it is returned by a belt to a McNally-Norton pick breaker for reduction to minus 5 in. and discharge to the washer-feed belt.

Washer Cleans Coal

The 5 or 6x$\frac{3}{8}$ coal at Maiden is cleaned in a five-cell McNally-Norton washer with automatic reject control. Primary refuse from the No. 1 elevator goes directly to the bin, while secondary refuse from the No. 2 elevator is passed over a shaker screen to separate it into plus and minus 1$\frac{1}{4}$-in. fractions. The undersize is run to the refuse bin and the oversize to the McNally-Pittsburg bony crusher noted above. Thus, the Maiden washer handles not only raw coal, crushed lump and crushed bony pickings but also a part of its secondary refuse, this to increase recovery.

Washed coal is dewatered and sized on a shaking classifying screen from which the various sizes (egg, nut and pea) go to their respective loading booms. Fines and water off the classifying screen are flumed to high-speed shaking dewatering screens, which remove minus $\frac{1}{2}$-mm. material and water. The oversize goes to the slack, while the minus $\frac{1}{2}$-mm. coal and water flow to a settling tank for dewatering and discharge into a separate refuse bin.

The original mixing conveyor at Maiden now is used as a cross conveyor to bring coal to a return conveyor to a new mixing conveyor across the egg (No. 1), nut (No. 2) and lump (No. 3) tracks. Thus, the new conveyor is able to put the coal on the back ends of the loading booms, which now are fitted with fingers to insure more thorough mixing. A belt boom is used for pea and is reversible to permit loading in the regular location or instead to take the pea 300 ft. back up track to a 25-ton bin from which it may be loaded on either No. 3 or No. 4 track.

Clarified water from the settling tank is recirculated to the washer by a McNally-Pittsburg centrifugal pump. Make-up water is obtained from the Monongahela River by means of two 800-g.p.m. American Well Works deepwell pumps. One is a spare and the one in use is operated to supply about 250 g.p.m. Spraying equipment has been installed for dustproofing all sizes with "Sealtite" or other desired dust-allaying medium.

The Maiden preparation plant has been supplemented by a Kanawha barge-loading dock on the Monongahela River. This dock is connected with the preparation plant by a belt conveyor and includes the necessary barge movers and a belt-type loading boom. As shown in an accompanying illustration, the boom support is counterweighted and the hoist is mounted on wheels running on a

crane track. Thus the boom not only may be raised and lowered but also may be swung from one side to the other for maximum-possible efficiency in loading.

Refuse disposal at mechanized mines in northern West Virginia usually is left to motor trucks, which haul to the nearest accessible disposal site. At Rachel, however, an aerial tramway, as noted above, is being installed for this purpose. And at Maiden, disposal is a combination of mine-car haul and aerial tramway. Washery refuse and pickings go into one bin at Maiden, with sludge into another. These bins dump into mine cars, which are hauled back about a mile toward the pit mouth to a Pittsburgh Coal Washer Co. rotary-dumping installation complete with the necessary storage tracks. The dump discharges the refuse into a bin feeding a 2,750-ft. Interstate aerial tramway of the one-bucket reversible type. Filling the 90-cu.ft. bucket is automatic. The tramway extends across a point of land, on which a saddle tower is mounted, and over a hollow to a concrete anchor pier on the opposite side.

An Interstate aerial tramway also was installed at Federal No. 1 mine in 1929 to replace cars and a horn dump. With the tramway, of the reversible type with one 40-cu.ft. manually loaded bucket, the refuse is taken across a hill to another hollow. Operating speed is 600 f.p.m. and the distance from the loading point to the saddle tower, 316 ft. higher, is 406 ft. The tail tower is 150 ft. higher than the saddle tower and is 874 ft. away.

Loading a larry with refuse at Jamison No. 8 mine.

An Interstate aerial tramway also was installed at Federal No. 3 in 1929, but since has been subject to considerable rebuilding to take care of an increase in refuse output. Prior to the tramway installation, tipple and mine refuse was dumped into railroad cars and then transferred to side-dump cars for final disposal. The greater ease with which disposal was handled with the tramway resulted in much more mine rock being brought to the surface, thus saving in many cases very laborious disposal underground but using up the original dumping life of twenty years in six. Rebuilding increased dumping capacity to about three times that originally available.

The No. 3 tramway is of the two-bucket reversible type. Filling of the buckets from a 75-ton bin, and also dispatching, are manual. Bucket capacity is 40 cu.ft.; operating speed is 820 f.p.m. Traction-rope size is $\frac{5}{8}$ in.; track rope, $1\frac{1}{8}$. Dumping is done on a hill about 230 to 250 ft. above the ground level at the tipple. Originally, the tramway was built with a saddle, or breakover, tower, an intermediate tower and a tail tower.

In rebuilding in 1937 the intermediate tower was eliminated, with the saddle tower remaining in position 700 ft. from the tipple. A special 110-ft.-long inclined section then was added on top of the original 125-ft.-high tail tower 1,850 ft. away to raise the track ropes and consequently increase dumping capacity. General arrangement of the new tail tower is shown in an accompanying illustration. It will be noted that the top section leans backward about 40 ft. and is guyed at the rear. This construction was adopted because the original tail tower with a vertical extension would not have been strong enough to stand the load without guying in front, which would have necessitated a costly excavation in the refuse pile. Leaning the new top section back resulted in a thrust toward the tipple at the joint and thus rendered front guying unnecessary.

Legs in Concrete

A further measure to increase capacity was incasing each tail-tower leg in concrete for a distance of 40 ft. up. As a first step, bent plates were applied to make a box section of each leg, which was covered with concrete made of crushed firebrick aggregate and Lumnite cement. Thus, it is possible to dump around the legs without danger of fire melting down the tower. A further measure against possible damage by heat was connecting the box sections with a 12-in. tile line, through which air can flow up through the sections to carry away the heat.

Larries take care of the refuse-disposal questions at the Katherine and Jamison Nos. 8 and 9 mines, the latter operations using Connellsville units to take the material a half to a mile away.

Tail tower of the Federal No. 3 tramway as it was rebuilt in 1937 to add to dumping capacity. As can be seen, the bottom of the tower has been incased in heat-resistant concrete.

ELECTRIFICATION

+ At Northern West Virginia Mechanical Mines

WITHOUT exception, electrification is complete at the mechanical mines in the Fairmont field of northern West Virginia studied by *Coal Age*. Steps taken to supply adequate d.c. power to face machinery draw the spotlight and these include a rectifier substation and welded rails. Bottled electricity jumps to prominence by reason of the installation of rubber-tired shuttle cars at several mines. Extremely low per-ton power costs characterize some of the full-mechanical properties.

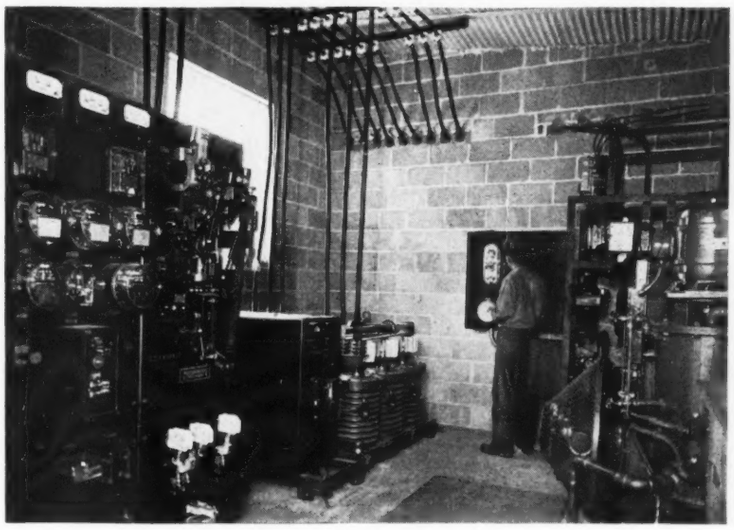
All the mines purchase all of their power from the Monongahela West Penn Public Service Co. In most cases the purchase voltage is 2,300 and the metering is done at one point. Except in two or three cases where old contracts are in force, the power company owns and maintains the main transformers. One mine, Emily, Monongahela Rail & River Coal Corporation, Monongalia County, is served by three metering points and three other mines (Federal No. 3, Koppers Coal Co., Monongalia County; and Dawson No. 2, Dawson Coal Co., and Eagle, Getty Coal Co., in Harrison County) each are served by two metering points. At these four operations, all drift mines, tipples are far from the active workings. Sixty per cent of the mines are drifts and more than half of those covered in the survey were opened in 1917 to 1920 inclusive. Frequently, therefore, the coal in the first hill has been exhausted and the mining is now back in the second or third. Four of the mines studied are in the Sewickley seam where working heights range between 4 and 6½ ft.; the remainder are in the Pittsburgh where 5½ to 7½ ft. of the 6½- to 9-ft. seam normally is taken and, as a rule, 12 in. or more of top coal is left in place. Over most of the field the coal beds dip 1 to 1½ per cent.

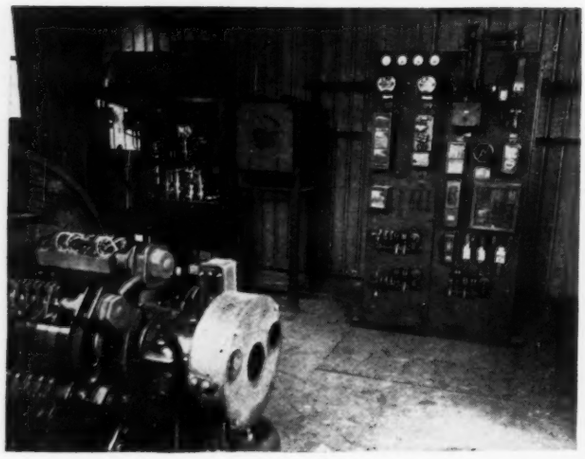
Direct current is used exclusively for cutters, drills and loaders and, of course, for all locomotives. Exceptions to the prevailing d.c. voltage of 275 are Dawson No. 2 and the Nos. 2 and 15 operations of the Pursglove Coal Mining Co., in Monongalia County, which operate on 550 volts. Pursglove No. 15, however, which is a consolidation of two old mines, inherited 275 for the active workings of one section and 550 for another section and all the main hauls. At fifteen mines, d.c. substations are on the surface and at five both underground and surface substations are in use. Totals show 35 surface substations and 6 underground for these twenty mines, the total studied from the electrification standpoint.

Synchronous motor-generator sets predominate. Two mines have synchronous converters only and three mines use one or more converters. Full-automatic substations supply d.c. power to five mines. At Louise mine, Louise Coal Co., in Monongalia County, a 200-kw. Ridgway motor-generator set with General Electric automatic board on the surface 7,000 ft. away is started and stopped from the tipple through No. 8 control wires mounted on the same poles with the 2,300-volt feed. This substation, rated at 738 amp. full load and carrying peak loads of 1,200 amp., is operated without an attendant.

Three outlying substations at tops of boreholes feed to Continental No. 4 mine, Continental Coal Co., Monongalia County. Two are equipped with 200-kw. m.g. sets and one with a 500-kw. unit. Each is accompanied by a full-automatic board. Other mines served by full-automatic substations are Mona, Arkwright Coal

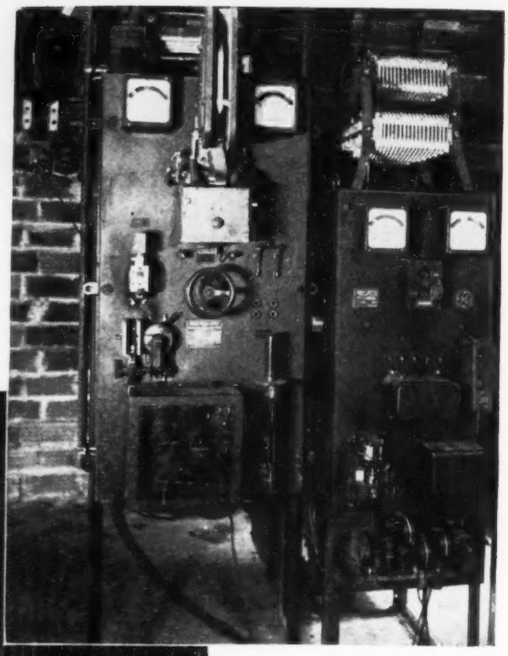
Christopher Mining Co., which operates this 400-kw. rectifier substation, has a lower power cost than any other full-mechanical mine in the district.



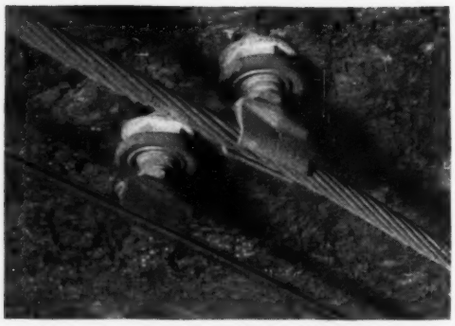


On the surface at the tops of boreholes at Continental No. 4 mine are two of these 200-kw. 300-hp. 0.8 power-factor full automatic substations and one 500-kw. station.

By means of this full-automatic control the 200-kw. outlying substation of the Louise Coal Co. is started and stopped from the tipple, 7,000 ft. away.

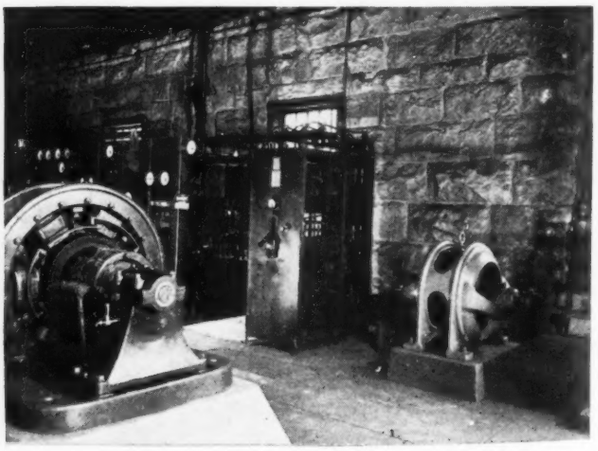


To the right of the man operating a switch back of the conveyor-belt take-up loop are the four sections of 440-volt capacitors in the Robinson Run No. 2 tipple.



Feeder on combination hangers in Rosedale mine.

The cabinet in the center background contains a 180-kva. 2,300-volt capacitor which improves the power-factor at Jamison No. 8 mine.



In Laura Lee, two 500,000-circ.mil feeders, the top one a positive and the lower a negative, are carried on the rib paralleling the No. 9-section trolley from the substation to the mechanical-loading section.

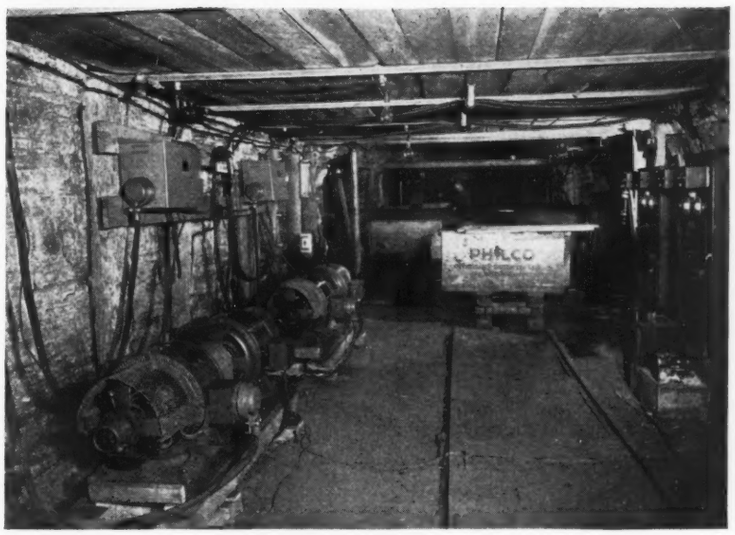
Co.; Maiden, Kelleys Creek Colliery Co.; and Robinson Run No. 2, Christopher Mining Co., all in Monongalia County.

The Christopher full-automatic substation, at the top of a 146-ft. borehole 6,000 ft. from the mine portal, is a Westinghouse mercury-arc rectifier of the Ignitron type rated at 400 kw., 275 volts and 50 per cent overload for two hours. It was installed in August, 1938, and has been operating in parallel with a 300-kw. motor-generator at the portal fitted with manual starting but automatic-reclosing feeder breaker. Rectifier efficiency is better than that of a motor-generator and this is one of several factors which have contributed to giving Robinson Run No. 2 one of the lowest per-ton power costs in the mechanical-mine group.

Because the metal tank (cathode) containing the mercury of a rectifier must be the terminal into which current flows from the power-system circuit, the trolley wire in Robinson Run No. 2 is negative and the rails positive. To operate the mine with the old standard (trolley wire positive) would necessitate the more costly insulating of the rectifier tanks from ground and guarding them to prevent accidental shock. The only possible objection to the reversed polarity is greater difficulty in controlling electrolysis of water pipes and metallic-sheath cables if they parallel tracks. This has not become a consideration in Robinson Run. One advantage of the negative trolley is that it provides the polarity best suited for steel arc-weld bonding and for other resistance welding where the work is at ground polarity.

Auxiliary equipment for the rectifier, housed in the concrete-block building with it and the full-automatic control board, consists of a mercury vacuum pump, which maintains the pressure in the tubes within the range of 4 to 14 microns, and tube-cooling equipment, consisting of a circulating pump and radiator with fan which starts when the water temperature reaches 40 deg. C. Electrical heaters switch on in cold weather when the tube temperature falls to 30 deg. C.

Single-shift production measured against total substation capacity ranges from 1 to 2.62 tons per kilowatt at the northern West Virginia mechanical mines. The latter figure is for Robinson Run No. 2, with 700 kw. installed and a production of 5,500 tons per day (three shifts). The 300-kw. m.g. set at Robinson Run is unusual in that the synchronous motor driving it is much larger than is standard for that capacity. It is rated 1,000 hp. and thus is able to handle any overloads which the generator can stand. The feeder breaker in this substation, at the main portal and near the central shop, permits 700-kw. peaks.



Two 10-kw. sets charging extra batteries for the rubber-tired shuttle cars in Consolidation No. 25 mine.

Pursglove has all its d.c. conversion equipment concentrated in one outside substation serving both its mines in the Sewickley and Pittsburgh seams. The station is two miles back in the country from the two preparation plants and adjoins a central machine and electrical repair shop where the chief electrician and master mechanic makes his headquarters. Controls are manual and shop repairmen always are on duty.

Breaker Protects Sets

Four 200-kw. motor-generators and one 500-kw. motor-generator in this Pursglove substation supply 550 volts d.c., and to protect these machines against flash-over a General Electric 3,000-amp. Type JR high-speed breaker is installed in the bus feeding the outgoing lines. This same substation contains one 200-kw. 275-volt motor-generator to supply the "B" side of the No. 15 (Pittsburgh-seam) mine whose workings are 90 ft. directly below those of the No. 2 mine (Sewickley seam). No. 15 mine is fed through three automatic-reclosing circuit breakers—one for the 550-volt main haulage, one for the 550-volt loading-machine section, and one for the 275-volt loading-machine section. No. 2 mine is fed through one automatic-reclosing breaker.

Power factor for the Pursglove load is maintained at 7 per cent lead entirely by adjusting currents in the synchronous fields of the substation units. Four companies have capacitors for power-factor correction. At Robinson Run a total of 90 kva. of Westinghouse Inerteen capacitors is divided into 45 kva. in the headhouse and the same in the tipple proper. Jamison Coal & Coke Co., operating in Marion County, has a Westinghouse 180-kva. 2,300-volt Type FP capacitor in the tipple substation at each of its two mines. At Mine No. 25, in Harrison County, the Consolidation Coal Co. has a General Electric capacitor at the transformer substation near the tipple.

Three to five thousand feet defines the limits to which the companies for the most part now transmit 275 volts d.c. and the latter figure is the ultimate limit that has been set by several. With mechanical loading, mine circuits of large capacity are necessary complements of such distances. Heavy trolley wire paralleled with large cables and in many cases a copper line in parallel with the rails are the assurances against low voltage.

Fifteen mines use No. 6/0 (nominal) or larger trolley wire, and seven, Federal No. 3, Laura Lee (Hutchinson Coal Co., Harrison County), Jamison Nos. 8 and 9, Maiden and Pursglove Nos. 1 and 15, are equipped with No. 9 deep-section grooved trolley wire, which has an area of 400,000 circ.mils and thus is almost as large as the calculated size for No. 7/0 (424,243 circ.mil). As a rule, the standards for trolley-wire construction are higher in this district than is general over the country. Wood trolley-wire guards are most common, although several mines now use guards

of molded rubber. As to distance from the face, the plan at Dawson No. 2 (non-gaseous) is to keep the trolley wire in rooms "right up to the last breakthrough." Most of the mines, however, end the wire at the room neck and in the gaseous operations open wires are kept well back from the faces. For instance, all trailing cables on d.c. machinery in Federal No. 1 are 450 ft. long.

Practically every mine studied carries a 500,000-, 750,000- or 1,000,000-circ.mil feeder in parallel with the trolley. Companies using the largest size are Koppers, Consolidation and Kelleys Creek. In some sections of Maiden mine (Kelleys Creek), feeders totaling 1,500,000 circ.mils are carried in parallel with a No. 9-section trolley wire. On 550-volt work in the Pursglove mines the practice is to use two No. 9-section trolley wires, one above the other in combination hangers. In all cases the feeders are bare and are mounted on the same side as the trolley. About one-third of the mines use combination hangers only; another third support the feeders on separate hangers, and the remaining third use both separate and combination units. Considerable of the Koppers feeder is hung on the rib and that method only is used in Laura Lee mine, where a return cable of the same size is mounted on the rib 18 in. below the positive.

At least ten mines use auxiliary return lines in parallel with the rails, and of this number about half use them only on relay and section roads, as compared to the other half which use them also along main hauls—that is, clear from the substation to the working section. In Mona, a 4/0 auxiliary return along relay and section hauls is mounted on the roof between the trolley wire and rib, and for this mounting trolley-wire clamps are used and are spaced 30 ft. apart. Water in this mine is acid enough to rapidly destroy copper lines left lying on the bottom. In the Jamison mines 500,000-circ.mil negative cables are hung on the rib 2½ to 3 ft. from the bottom. In Maiden, feeder of the same size, also mounted on the rib and extended to within 200 ft. of the pillar line, is tied to the track at intervals of 400 to 600 ft. In the Pursglove mines, where welded rail joints are the standard practice on all but temporary haulways, 2/0 or 4/0 auxiliary returns are used from the ends of the welded sections.

Three of a total of 4½ miles of 80- and 60-lb. main-line track in Pursglove No. 15 mine now is arc-welded. No splice bars or angle bars are used and rail ends are not beveled. Rail ends are spaced ½ in. apart and a ⅜-in. steel plate cut 6x10 in. is placed under the joint. All exposed joint surfaces are welded and in addition both sides of the rail base are welded to the plate. Maximum cost is $1.75 per joint, against $4.75 using bolted angle bars and bonds. For this welding a portable 300-amp. motor-generator was used with Fleetweld No. 7 rod. Had the job not been of the rush type it is felt that the cost of $1.75 per joint could have been bettered considerably. The type of welded joint selected was the result of numerous breaking and conductivity tests on joints of various designs. Cross bonds consisting of steel bars cut from ½x4-in. stock are applied at switches. Prior to adopting arc-welding of rails in No. 15 mine the company had brazed three miles of track in No. 2 with gas.

On main haulways most companies in the district use 60- to 85-lb. rails. Arc-welding is used exclusively in bonding. Two companies, Koppers and Dawson, use the copper-alloy-electrode type instead of the steel-electrode type. Koppers officials point to ease of reclaiming and state that some bonds have been used as many as five times. At Dawson, less difficulty is encountered in obtaining a good welding job when using the resistance-type welder with the normal negative polarity of the rail, which is the wrong polarity for the best job of steel-electrode welding. In Federal No. 3 mine, 2- to 6-in. steel water pipes, when in a heading with a track, are bonded to the track at 500-ft. intervals. Objects are to utilize the pipe as an electrical conductor, prevent electrolysis of the pipe, and promote safety. Pin-driven bonds are used on temporary track in several mines, such as Consolidation No. 25, which uses the new O-B wedge-type bond on tracks serving the rubber-tired haulage section.

Table I—General Power Data, Northern West Virginia Mechanized Mines

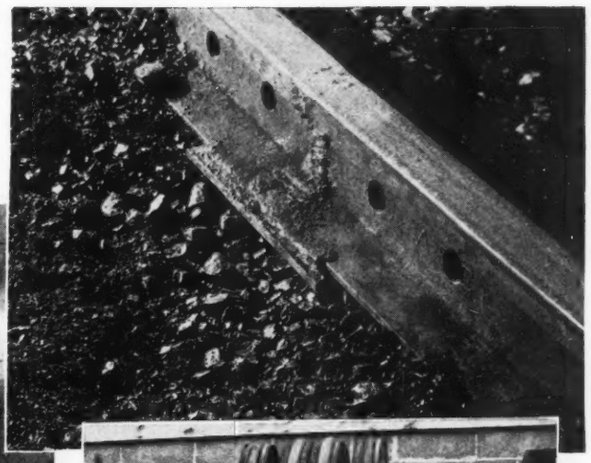
	Average	Minimum	Maximum
Tons per shift per kilowatt of 15-minute maximum demand.	1.86	0.85	4.95
Power cost (cents) per ton shipped....	6.75	3.37	11.70
Power costs (cents) per kilowatt-hour...	1.30	0.91	1.64
Kilowatt-hours per ton shipped	6.06	2.28	9.61

This surface, which is part of a 165-ft. screening and picking unit at Emily mine, is illuminated by ten 200-watt Mazda lamps in reflectors.

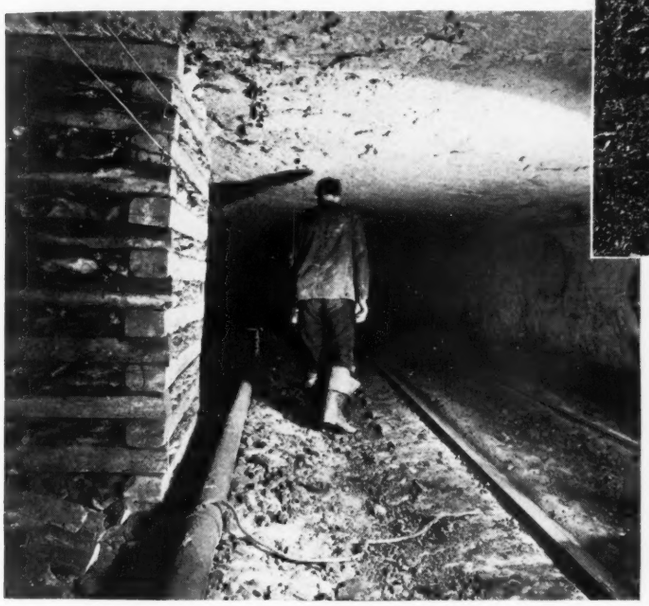
For the most part, boreholes feeding power into the mines are 100 to 500 ft. deep. As a rule the cables have non-metallic protective coverings and are supported by the conductors. Lead-sheathed and spiral-wire-armored cables are used in a few instances, especially on older installations. With d.c. non-metallic-covered cables, a favorite supporting method is to loop the cable around a wooden sheave or other large round object and secure it by clamping the two ends of the loop together. At Maiden mine, wooden sheaves are used and at Continental No. 4 mine the round support is a 6-in. pipe insulated with a wrapping of varnished cambric and friction tape.

In a 525-ft. borehole lined with 8-in. casing and conducting d.c. into Federal No. 1 mine, four 1,000,000-circ.mil Anaconda cables are supported by potheads which include terminals applied to the cables by

Three miles of track in Pursglove No. 15 mine have been arc-welded with a reinforcing plate on the bottom of the joints.

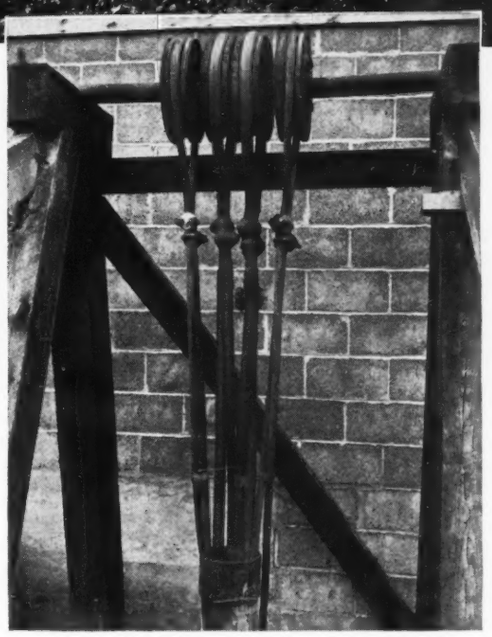


Water pipes (2- to 6-in.) along main hauls are bonded to the rails every 500 ft. in Federal No. 3 mine.

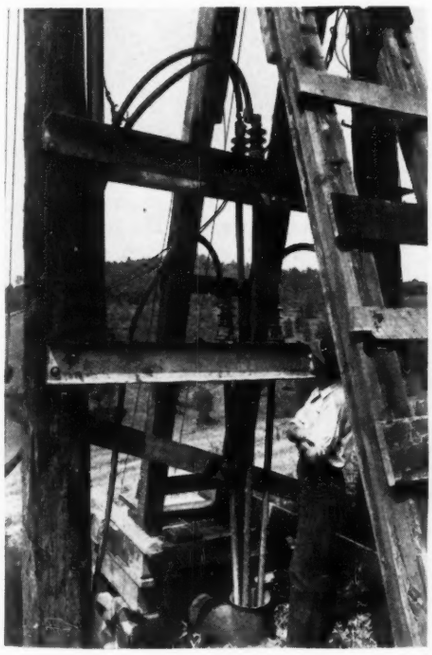


Below — Potheads with terminals applied to the cables at the factory serve as suspensions for the 525-ft. 1,000,000-circ.mil d.c. borehole cables at No. 3 substation, Federal No. 1 mine.

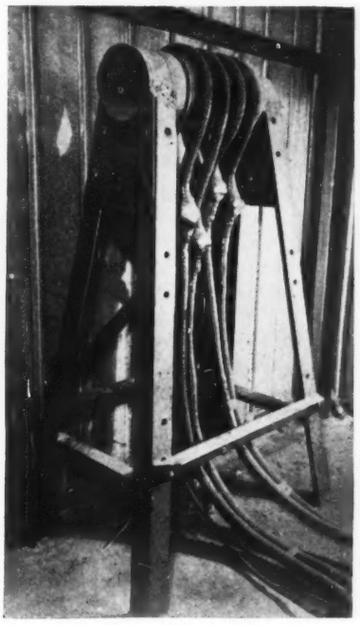
Right—Four 1,000,000-circ.mil d.c. feeders entering a 381-ft. borehole at No. 4 "Hill Top" substation at Maiden mine. The two center cables (positive) have rubber jackets.



Below—6 in. pipe insulated with cambric and tape supporting 500,000-circ. mil borehole cables 280 ft. long, Continental No. 4.



Right—This 1,550-ft. trench 2 ft. deep leading to new boreholes for water discharge and electrical feed at the Pursglove mines will receive two 750,000-circ.mil d.c. cables, a 2,300-volt 3-phase cable and a 2-conductor telephone cable.



This 20-hp. motor geared to the head pulley of the 600-ft. run-of-mine conveyor from headhouse to tipple at Robinson Run No. 2 returns 15 kw. to the line.

the manufacturer. The two cables which form the positive line are rubber-and-braid insulated and the other two (negatives) are bare. The largest cables used in the district are 1,500,000-circ.mil. These are spiral-wire-armored d.c. cables in a borehole at Federal No. 3.

Burying rubber-sheath cables in trenches in the fields is a recent practice at the Pursglove mines in transmitting from the central d.c. substation to boreholes. The latest installation is in a 2-ft. trench 1,550 ft. long from an existing borehole to a new borehole where a 440-volt pump station has been installed underground. The trench contains a 750,000-circ.mil insulated positive, a bare negative of the same size and a three-conductor No. 6 cable for conducting 2,200-volt a.c. power to 2,200/440-volt transformers at the top of the borehole. These d.c. and a.c. cables are Roebling. In the same trench is a rubber-insulated lead-sheath two-conductor No. 18 telephone cable.

In only a few instances are 2,300-volt cables installed along headings in the mines. A recent installation is a new General Electric three-conductor trench-lay cable in a slot in the rib in Maiden mine. This extends 300 ft. along an aircourse from an underground substation to a 150-hp. 2,300-volt mine pump. The pump motor just mentioned is the largest in any of the mechanical loading mines of the district. Few 2,300-volt pump motors are in service. By far the greatest number of main pumps are driven by d.c. motors of 20 to 75 hp. Several mines, however, use 440-volt a.c. on main pumps and all of the motors are induction units.

Four mines (Laura Lee; Consolidation No. 25; Katherine, Katherine Coal Mining Co., Harrison County; and Rachel, Jones Collieries, Inc., Marion County) had installed 5- or 6-ton rubber-tired Joy shuttle cars behind loading machines at the time of this survey (see article beginning on p. 51). Use of this equipment results in material changes in the electrical set-up. A motor-generator charging station is required in the working section and rails with their electrical-return problems are eliminated. Mining machines of the top-cutting, or top-cutting and shearing, type must be crawler-mounted and one operation uses a coal drill on rubber tires.

Three series-wound motors of 3- to 5-hp. operate a shuttle car. Two are geared to the axles and one to the conveyor in the bottom of the car which does the unloading. Ninety volts average operating potential is supplied by a 48-cell lead battery and each car is equipped with an extra battery which is left at the station under charge while the other battery works a shift. Exide-Ironclad batteries are used at the Katherine and Laura Lee mines, Philco at Consolidation No. 25 (330 amp.-hr.), and Gould at Rachel.

A battery-charging unit consists of a 10-kw. 132-volt d.c. generator direct-driven by a 15-hp. 275-volt d.c. motor, and a panel with ampere-hour meter and the necessary resistance and relays to cut the charge at a predetermined setting. Laura Lee and Rachel, with two shuttle cars and four batteries each, have one charging set apiece, and Consolidation No. 25, with three cars and six batteries, has two sets.

Run 180 Miles a Day

Two new 15-ton General Electric main-line locomotives which haul the 5,500-ton output of Robinson Run No. 2 mine each travel 180 miles per day. A round-trip haul is 3½ miles and each locomotive averages fifteen trips per shift, three shifts per day. These units have a rated drawbar pull of 6,500 lb. at 10 m.p.h. Wheels are 36 in. in diameter, journals are Timken-equipped and the controls are contactor type with dynamic braking. Track steel is 85-lb. Grades average 2 per cent against the loads, with a maximum of 2½ per cent, and a trip consists of sixteen cars (car, 6,500 lb.; coal, 10,000 lb.).

Eleven miles per hour is the rated full-load speed of a new 20-ton Jeffrey locomotive working in Mona mine on a 9,000-ft. haul averaging 3 per cent against the loads. This unit, driven by two 150-hp. motors with blowers, has anti-friction bearings throughout, is equipped with air brakes and air sander and contactor control without dynamic braking. On the main hauls in Maiden mine, three tandem locomotives, all with dynamic braking, are in use. One consists of two Westinghouse 10-ton units; another, two Jeffrey 15-ton units with Timken journal bearings; and the third, two Goodman 15-ton units. The general run of main-haulage locomotives at other mechanical mines in the district are 10-, 13- and 15-ton units with brass journal bearings and drum control.

All but two of the mines use relay locomotives, otherwise spoken of as "intermediate" and "flat-road" units. They range from 6 to 15 tons and all are trolley units except that in Rachel mine two 10-ton Whitcomb locomotives each are powered by a 63-cell 37-plate Gould-Kathanode battery rated 102 amp. for 6 hours. In Louise mine, the one relay unit consists of two 6-ton General Electric locomotives hooked permanently in tandem.

Eighty per cent of the gathering locomotives are 6-ton units. The largest is 8 tons (Maiden and Robinson Run No. 2 mines). Use of one locomotive per loading machine is the general rule, with two in some cases at the Jamison mines. In Rachel mine, car changing is done with 6½-ton Ironton locomotives with 42-cell 33-plate Gould-Kathanode batteries rated 90.67 amp. for 6 hours. Most of the trolley-type gathering locomotives are built for a full-load speed of 6 m.p.h. Out of twelve locomotives, however, Continental No. 4 has eight which are rated 4 m.p.h. In car-changing ability no difference of consequence is noted as compared to the faster type but power and maintenance costs are definitely less. Therefore it is planned to change the remaining four 6-m.p.h. units to the slower speed. In the purchase of new Jeffrey 8-ton cable-reel locomotives for car-changing duty the "happy medium" (5 m.p.h.) was selected by the Christopher Mining Co.

Table II—Comparison of Total D.C. Power Used at Consolidation No. 25 With Hand and Mechanical Loading

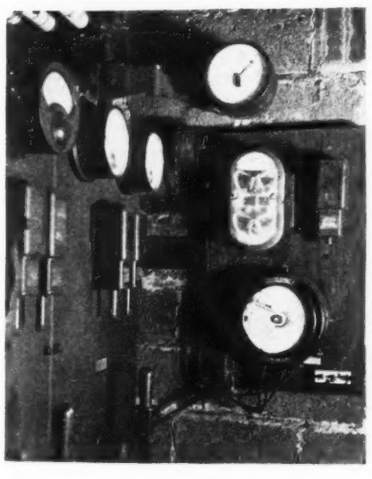
	Hand Loading*	Mechanical Loading With Rubber-Tired Shuttle Cars
Power cost per ton, cents...	2.45	3.74
Kilowatt-hours per ton.....	1.467	2.33
Cost per kw.-hr., cents...	1.67	1.60

* During hand loading most of the production was gathered with cable-reel locomotives; the remainder with stock.

As indicated in Table I, power cost per ton for the mechanical-loading mines in northern West Virginia averages 6¾c. per ton of coal shipped. The minimum is about 3½c. The latter is a fairly conclusive figure because of favorable working conditions of companies in the lowest brackets; however, the average figure does not merit as much weight because only ten companies were represented in the detailed data from which the data were compiled. Incomplete mechanization and short running time are among the reasons which kept the rest of the mines out of the power-data picture.

For a completely mechanized mine, Robinson Run No. 2 is the outstanding example of low power cost per ton. This drift operation, using seven Joy 10BU and 11BU machines and operating three shifts, ships 5,500 tons per day. During June, 1939, when 109,000 tons was shipped, the power cost was 3.4c. per ton and the consumption 3.06 kw.hr. per ton. Fifteen-minute maximum demand was 957 kw. and the net power bill figured out to 1.11c. per kilowatt-hour. Mine officials, when asked to enumerate the reasons for the unusually low power cost, began by stating that "the mine was planned that way." Other reasons were: three-shift operation of loading machines; three-shift operation of the tipple, which was designed with equipment of minimum size; small fan load, relatively few mine pumps and selection of a rectifier for the larger of the two substations. A regenerative belt and other power-saving conditions at the tipple, which is without mechanical cleaning, will be discussed later in the article. All the natural conditions at the mine are not favorable. As mentioned earlier, the Robinson Run main haul averages 2 per cent against the loads.

After a load dispatcher in Continental No. 4 has done what he can to reduce demand, the meter at the lower right cuts off all d.c.



Power requirements (entire d.c. load) for hand-loading with cable-reel-locomotive gathering and also for mechanical loading with rubber-tired shuttle cars at Consolidation No. 25 are given in Table II. Power cost increased only 1.29c. per ton with mechanical loading. However, an exact comparison, if available, would show a smaller increase because some gathering was done with stock during hand-loading. Tests on 48-cell shuttle cars in this mine indicate an average of 0.152 amp.-hr. per ton per 100 ft. of distance from face to the point of transfer of load to the mine cars.

Coal hoists for both slopes and shafts at the mechanical mines all are powered by wound-rotor 2,300-volt induction motors with grid-resistance contactor controls. The size range is 150 to 900 hp. The one 900-hp. motor is a General Electric 900-r.p.m. unit at Federal No. 1 main shaft, where the daily production (hoisting two shifts) is 7,500 tons and the total hoisting distance is 301 ft. The second largest is a 700-hp. 709-r.p.m. Westinghouse motor on the shaft hoist at Jamison No. 8 mine. At both of the slope-haulage mines, Bunker, Davis-Wilson Coal Co., Monongalia County, and Continental No. 4, the hoist operator is stationed at the dump.

220 and 440 Used

As to tipple-motor voltage, the mines are about equally divided between 220 and 440. Ten to 15 motors and a total connected horsepower ranging from 80 to 200 will catch most of the plants which do not include mechanical cleaning. Fifty horsepower is the largest motor used in any preparation plant in the district. The new McNally-Pittsburg tipple and washing plant at Maiden mine uses 440 volts and the total connected load is 720 hp. Two other cleaning plants of fairly recent construction, these at the Pursglove mines (Chance cones), also have 440-volt motors. No. 2 tipple and cleaning plant contains 22 motors totaling 452 hp. and No. 15 has 15 totaling 387 hp.

In every case the larger plants, including the new installations, use the position-sequence arrangement of individual starting buttons. At the Pursglove plants the controls are interlocked in three groups, any one of which will stop automatically in case the leading unit stops for any reason. Westinghouse De-ion starters are used exclusively in the Continental No. 4 tipple and washer. In Pursglove No. 2, the Westinghouse starters with thermal overloads have the added protection of a Westinghouse De-ion instantaneous overload circuit breaker connected ahead of each. In Pursglove No. 15, General Electric starters are used and ahead of each is an I-T-E instantaneous-overload circuit breaker. Rigid conduit is used in the Maiden and Pursglove plants, but Continental No. 4 is wired throughout with BX.

This new meter in Continental No. 4 tells the dispatcher when to hold up trips if such is possible without interfering with production.

High-intensity mercury vapor lamps in combination with Mazda units constitute the picking-table illumination at the Rosedale mine of the Rosedale Coal Co. (Monongalia County) and at the two Jamison mines. The Mazda lamps supply light during the 10- to 12-minute warming-up period of the mercury lamps and for use in case low voltage or other difficulty causes one or more of the mercury lamps to go out. Other companies using high-intensity mercury lamps are Koppers, Continental and Christopher.

Mazda lamps of 200-watt size in open-type RLM reflectors are used over the tables at the Emily and Mona mines. At Emily, the Marcus table is illuminated by fourteen of these units mounted 40 in. above the table in two rows 6 ft. apart. Each table at Mona mine is equipped with five units spaced 4 ft. and mounted 5½ ft. above the surface. Picks are used for breaking coal on the lump table, which explains the unusually high mounting. In the Pursglove plants the table lighting consists of 500-watt Mazda lamps in dust-tight reflector units.

Prominent among the power-saving methods observed at mechanical mines in northern West Virginia is the demand limiting in use at Continental No. 4 mine. Limiting has been practiced at this operation

since 1926 but has been improved from time to time. The last change, made in 1936, was adding a General Electric Type GM-10 demand meter underground in the dispatcher's office to supplement the former automatic limiting with manual limiting. A Type G-9 meter of the same make installed in the hoist house automatically stops the tipple as a first step. The next step opens the d.c. breaker in the substation near the tipple. Action of this breaker operates a contact which energizes control lines to the three other substations at the tops of boreholes and opens the d.c. breakers, thus cutting off all d.c. loads. With the present setting of 1,550 kw. the d.c. is cut off three to four times per week and the demand is held to under 1,600 kw.

Before the meter was installed in the dispatcher's office the limit had to be set considerably lower to guarantee the same limit of actual demand. Consequently, the d.c. breakers were opened oftener. As the dispatcher notes that actual demand is running ahead of proposed demand he holds up a main-haulage, relay or gathering locomotive if it be on a sidetrack and its delay will not materially affect production. At Maiden mine, a degree of limiting is effected by an instantaneous-overload trip on the main oil circuit breaker which feeds the entire operation. With its present setting it operates about once a week. There are no fuses between the power company's line and the coal-company load.

Regenerative braking of the 600-ft. belt conveyor from headhouse to tipple at Robinson Run No. 2 mine returns 15 kw. to the line. Although the plant handles 5,500 tons per day, the net demand is but 33 to 35 kva., and during June, 1939, when 109,000 tons was shipped, the tipple used only 12,160 kw.-hr. The belt is on a 11-deg. slope, operates at 300 f.p.m. and the drive is General Electric 20-hp. 440-volt fan-cooled totally inclosed motor with Thrustor brake and Link-Belt speed reducer.

Eliminating grades on main hauls, moving metering points to the centers of load and providing sufficient pumps so that the mine drainage can be handled during off-peak periods are among the other means being followed to save power. At Louise mine, for instance, a half mile of new outside haulway will provide a uniform 1-per-cent grade in favor of the loads and will replace an inside haul having grades of 4 to 8 per cent against the loads. At Mona mine the metering point is being changed to a substation at a new borehole which is near the center of the active section.

MAINTENANCE AND SUPPLIES

+ At Northern West Virginia Mechanical Mines

AT HALF of the mechanical-loading mines in the Fairmont field of northern West Virginia covered in the *Coal Age* survey the chief electrician is responsible for stocking repair and supply items. Because of this close relationship, the maintenance of equipment and handling of supplies are here treated in one article. When, where and how to overhaul loading machines, a relatively new problem in the district, takes first rank. Except in locomotive-tire practice, maintenance of mining equipment follows closely the pattern of the industry in general. At several of the larger mines, supply houses in charge of supply clerks and with modern steel-bin equipment are maintained on a strictly perpetual-inventory basis, under which parts are charged to operation only as used.

At Robinson Run No. 2 mine in Monongalia County, the Christopher Mining Co., which began using loading machines in 1935, determines entirely by inspection when a particular loading machine must undergo a general overhauling. Seven of nine Joy loaders (five 11BU and four 10BU) are in use triple-shift, leaving two spares, one for general overhaul in the shop and the other subject to call. At Maiden mine of the Kelleys Creek Colliery Co., also in Monongalia County, where the equipment consists of nine 11BU loaders and where the overhaul date has been determined by inspection, it is planned to change to overhauling after every 100,000 tons, subject to adjustment in accordance with the quantity of mine rock the machine must handle.

In the two Pursglove Coal Mining Co. operations in Monongalia County, which together have eighteen 7BU loaders, the inspection basis prevails. At the two Jamison Coal Co. mines in Marion County, the first general overhauls were made during the suspension in April and May this year. At that time two Goodman Type 260B machines installed in March, 1938, were completely reconditioned. The loaders of a number of other companies in the district still are so new that general overhauls have not become necessary. At Federal No. 1 and No. 3 mines of the Koppers Coal Co., Marion and Monongalia counties, "Grade A" (general) overhauls are given each loading machine after six months of service. Electric coal drills get this Grade A overhaul after three weeks.

Emily mine, Monongahela Rail & River Coal Corporation, Monongalia County, where three Whaley "Automat" machines (installed early in 1935) work three shifts, had given only one of the units a general overhaul at the time of the *Coal Age*

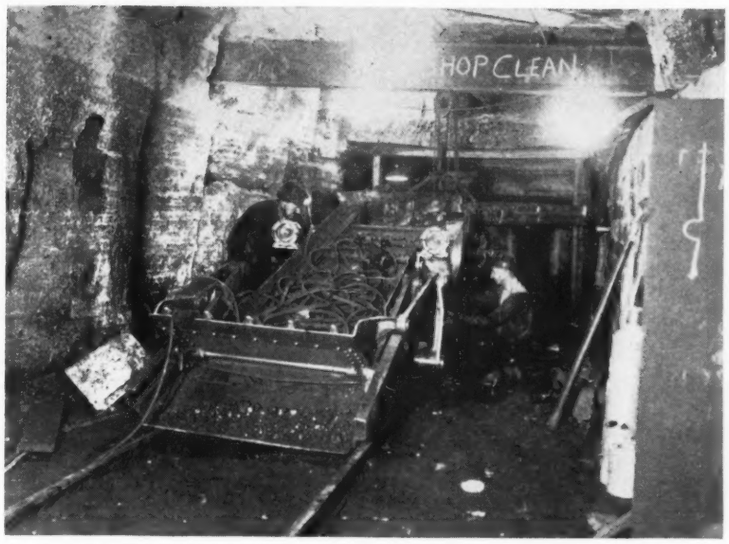
survey. The cost of that job was $1,000, of which two-thirds was labor. As the above citations indicate, many companies as yet have not gained sufficient experience in general overhauls to formulate a standard practice.

Who lubricates the loading machines—crew members or the maintenance force? The mines are divided about 50-50 on that question. Generally speaking, the crew men do the lubricating at the smaller mines, and at the larger operations, or at mines owned by larger companies, maintenance men or special lubricating crews do the greasing. Special trucks with power-driven grease and oil pumps are used at several mines. One at Jamison No. 8 must be used in connection with another truck which carries an air compressor to operate the grease guns. At Maiden mine the greasing truck has its own motor-driven air-cooled compressor.

Where maintenance men do the greasing this work usually is combined with routine inspection. Complete stem-to-stern inspection once a week is the practice at a majority of the mines. As a rule, only running repairs are made at the face and extensive shops are not set up near the sections. At Emily mine, where the working territory is 2 miles from the shop at the pit mouth, the "Automat" loaders, in case of a breakdown, are brought outside if the mine is idle and the repair job will take more than an hour. At Louise mine, Louise Coal Co., Monongalia County, Joy 8BU and Jeffrey 44-D loaders, if the time to make a repair promises to be as much as 4 or 5 hours the loaders are taken out to the shop at the drift portal. Loaders with "cats" are pulled the 2 or 2½ miles with a locomotive in 30 minutes, which does not appear to damage the cat treads appreciably.

Both electrical and mechanical work at practically all the mines is supervised by a chief electrician. Or he may be termed "master mechanic" or carry both titles. At Federal No. 3, the chief electrician reports first to the mine superintendent and then to the division electrician, with headquarters at Federal No. 1.

At Robinson Run No. 2, the largest producer among the full-mechanical mines, the chief electrician and master mechanic is in charge of all maintenance, with his office in a shop at the drift portal. On the day shift he has one man in charge inside of the mine and does not have any men assigned individually to any of the seven loading units.



Only repairs of an hour or less are made in this inside shop at Emily. For more extensive jobs the loaders are taken outside.

He has another man in charge of mechanics and electricians in the shop. In case of extensive trouble with a machine, the inside man calls for help from the shop and the men assigned then report to this inside maintenance man.

Robinson Run shop has only a few motor-driven tools, such as drills and emery wheels, and does not include a lathe. Because so many of the shafts used in modern mining equipment are heat-treated, less lathe work can be done than in years gone by. Mine officials expect to continue without a lathe unless the total cost of that type of machine work by commercial shops exceeds the wages of an expert machinist.

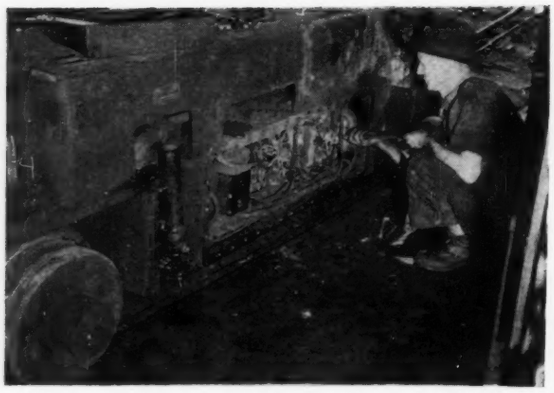
Central Shop Operated

Pursglove operates a central electrical and machine shop in conjunction with a central d.c. substation back in the country 2 miles from the two preparation plants. Machine equipment includes a locomotive-tire lathe. Armature winding is done in this shop and it is one of three mechanical-mine shops in the district that do winding. All other companies send that work to commercial shops.

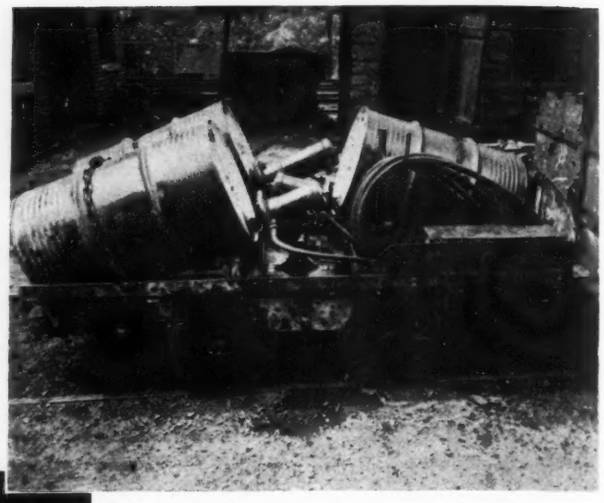
Practically every mine is equipped with a motor-generator welder and several have two or three. Pursglove, 6,000 tons per day from two mines, uses approximately 3 tons of welding electrode a year, but as a result of arc-welding of track joints this is expected to increase materially. Continental Coal Co. maintains a machine shop at Rivesville, several miles from the Continental No. 4 mine in Monongalia County. That shop also has a lathe for tire turning. Machine and winding work from Consolidation Coal Co. No. 25 mine, Harrison County, is done 20 miles away at Monongah, where the company operates a large central shop for its West Virginia division.

That none of the northern West Virginia mechanical mines find it economical to fill locomotive tires by arc-welding contrasts with practice in many other fields, some of which number more than half the mines in the tire-welding class. In northern West Virginia the common practice is to turn the tires once or twice, thus getting two or three wears from them before junking. At Consolidation No. 25, practically all the locomotives are equipped with rolled-steel wheels in accordance with a company practice of several years' standing. Pursglove and Getty Coal Co. (Eagle mine, Harrison County), which turn tires in their own shops, do this without complete annealing. Hard spots are cut with a portable grinder in the Pursglove shop, while at Eagle the spots are annealed with a torch. At the Rosedale mine, Rosedale Coal Co., Monongalia County, tires seldom are turned. After one wear they are cut off with a torch and new tires applied. Demountable tires of the bolted type were tried at Rosedale but gave trouble, due to corrosion of the parts. Pursglove reported use of abrasive brake shoes, but this use is not extensive.

A large percentage of the mines use standard cutting chains and bits, and in most cases the bits, after sharpening, are quenched in a soap solution and then sent into the mine.



Above—Once a week, at Robinson Run No. 2, all equipment is given a thorough inspection and the necessary running repairs are made.



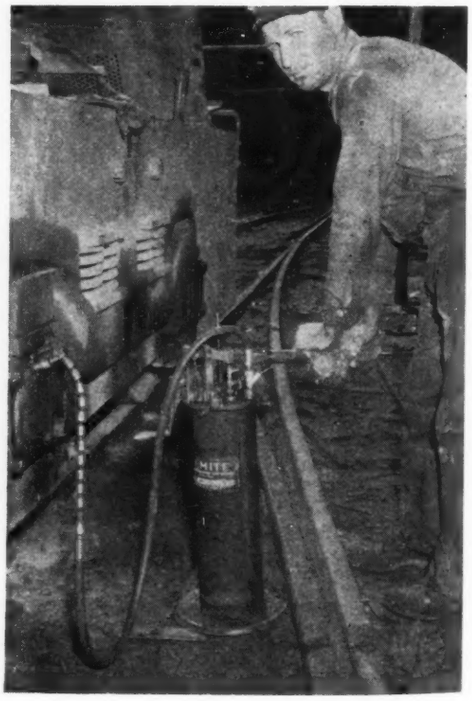
Greasing truck ready to go into Jamison No. 8 at the end of the second and last shift.

Above—Operators greasing a few points on loader in Jamison No. 8 mine. General greasing is done by maintenance men after the second shift.

Below—Rack near the main shaft, Continental No. 4, where 3-pint grease guns are stored ready for the locomotive and mining-machine crews.

Assembling an armature unit in the Robinson Run No. 2 shop.

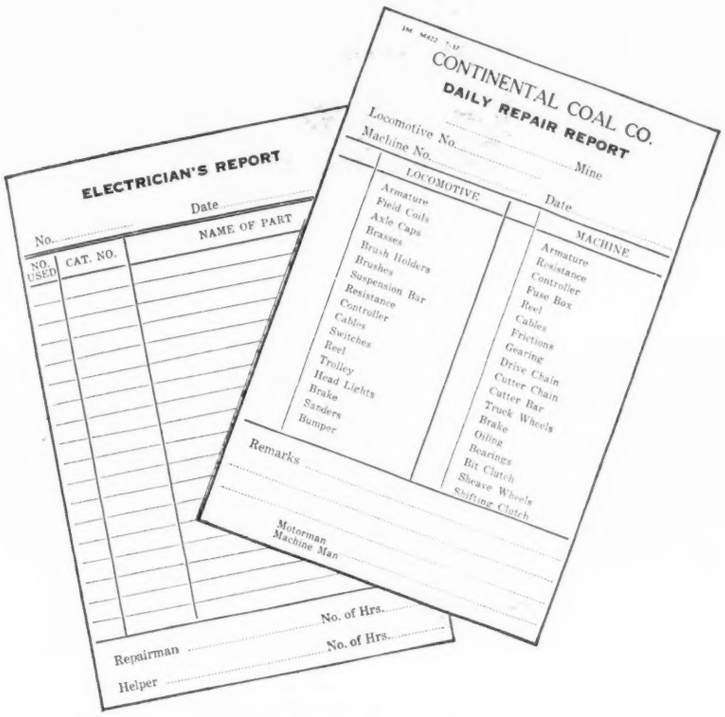
Right—Weekly greasing of anti-friction journal bearings of 15-ton locomotives which run 180 miles per day at Robinson Run No. 2.



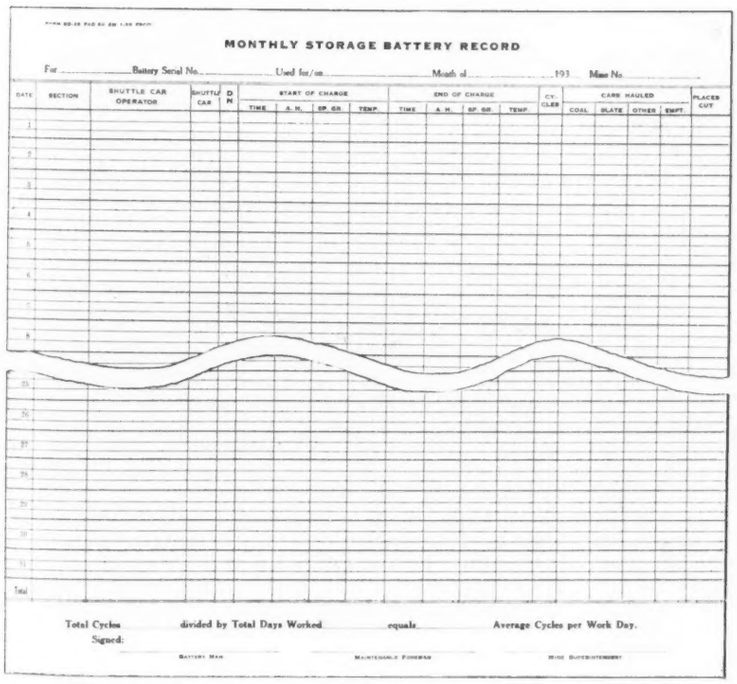
Tipping, although done by several companies, has not been widely adopted because of the prevalence of sulphur balls, which soon ruin any bit. Four companies use patented chains with throw-away-type bits. Bowdil chains and bits are used on some of the machines at Emily mine and at the two Pursglove mines. All cutting machines in Rachel mine, Jones Collieries, Inc., Marion County, are equipped with Cincinnati chains with Duplex bits. Prox chains and bits are used on two machines at Continental No. 4.

Bit changes were reduced one-third at the Federal mines by tipping with Haystellite, which is applied with a gas torch at a central bit-sharpening plant at Federal No. 1. Grinding to clean the bit is not necessary for application of this material. On an extensive test, comparative power cost per 1,000 sq.ft. of cutting was $0.48 with plain bits and $0.465 with tipped bits. Per 1,000 tons, the respective power costs were $2.39 and $2.12. For five years at the Jamison mines, bits have been tipped with Stoodite and the sides of the tip are ground after sharpening.

A pair of 1,250-ft. 1¼-in. flattened-strand-type ropes on the slope at Continental No. 4 mine are expected to hoist at least 2,350,000 tons, according to performance records of previous ropes. The ropes are turned end for end at the end of the first half of their estimated life. At Federal No. 1 shaft mine, the largest producer in West Virginia, 500,000 tons per rope is normal performance. At the Jamison mines, ropes are renewed on a time basis, usually after eighteen months of normal operation. Babbitt is used there when socketing new ropes and when cutting off and resocketing during the life of a rope.



Machine operators report difficulties on one side and the repairmen describe the work done on the other.

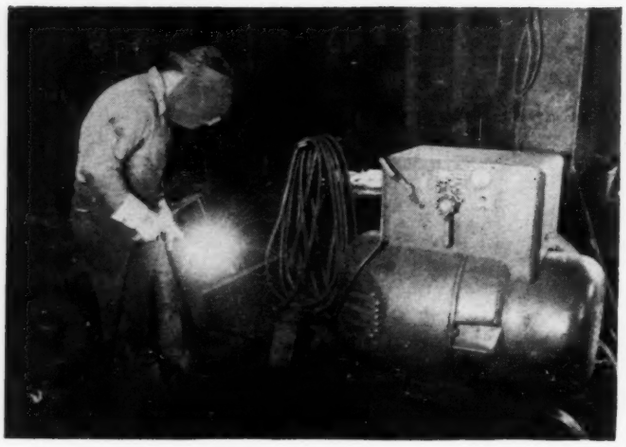


Only slight changes are necessary to adapt the Consolidation battery-locomotive forms to rubber-tired haulage.

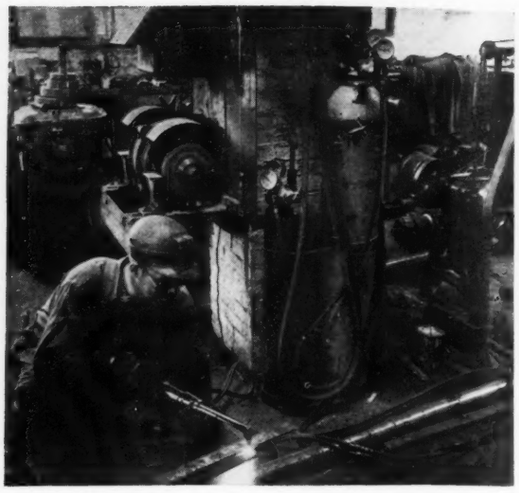
Modern Tools Used

New machinery with better steels and assembled to high standards of accuracy calls for modern repair tools. The trend is indicated by two items observed at Consolidation No. 25 mine. Chrome-vanadium box wrenches were in evidence. One with a wide range of usage is the Williams "Multi-Socket" No. 1999 wrench, which combines eight sizes in the range from ¼ to ¾ in. The other item pertains to twist drills in general shop work. The old carbon-steel drill is recognized as a back number and now nothing but high-speed drills are purchased for the West Virginia division.

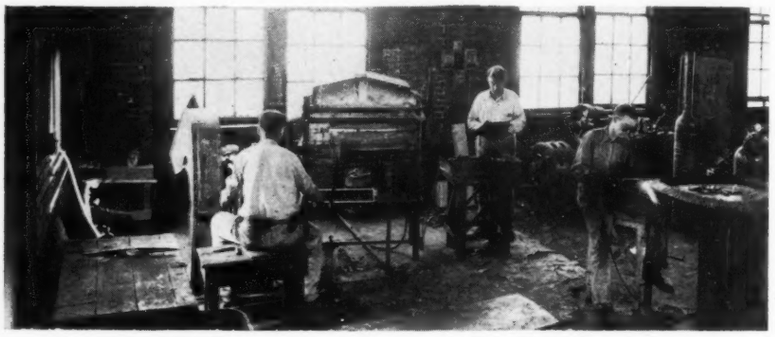
Betterments to the older types of mine locomotives have been made at several mines. Anti-friction bearings have replaced sleeve bearings and in two or three cases roller bearings have been installed on armatures to replace ball bearings. At Rosedale, where this was done on two 15-ton locomotives, the mine officials give as their reason: roller bearings will not allow an armature to drop onto the pole pieces, as will a ball bearing, in case of failure of a retainer. Resistance failures occurred often on locomotives at Emily mine. Three years ago five units



This arc-welding set in use at Rosedale is typical of one of the most valuable maintenance tools. Some mines have two and three of these sets in addition to resistance welders for bonding.

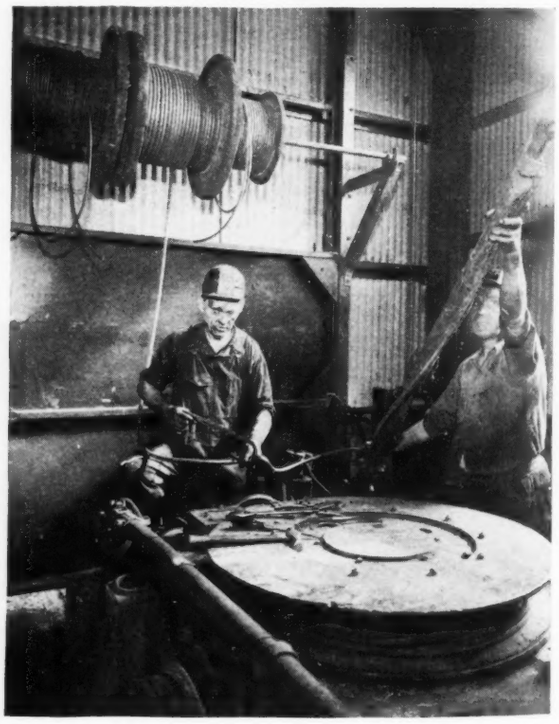


At all mines the gas torch, as seen here in use in the Pursglove shop, is considered indispensable for cutting, brazing and certain types of welding.

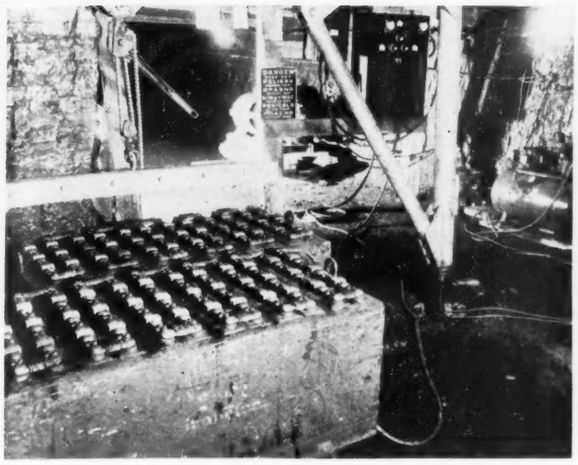


Bit sharpening and tipping at Federal No. 1 shop. Bit changes at the Federal mines were cut one-third by adopting tipping.

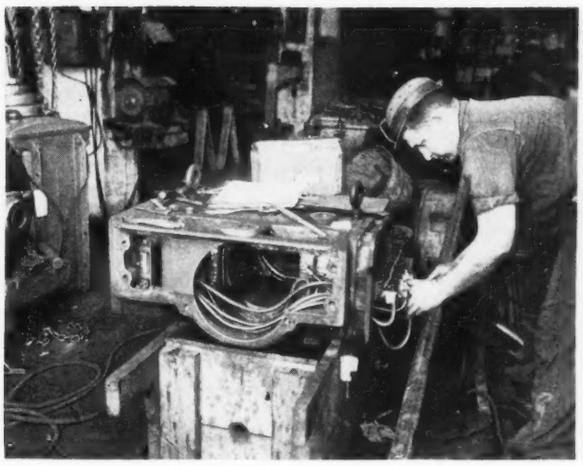
For five years bit tipping has been the practice at the Jamison mines. The sides of the point are ground after tipping.



Three sizes of asbestos-covered cable mounted overhead in Maiden shop. The repairmen measure and cut a piece to extend from trolley harp to fuse block. All d.c. equipment is wired with asbestos cable.



Batteries for rubber-tired shuttle cars on charge in Laura Lee mine. They are handled with a swinging roof-jack crane equipped with chain hoist.



Installing asbestos connection cables in a mining-machine motor in the central electrical and mechanical shop of the Pursglove Coal Mining Co.

were equipped with General Electric "Edgewound" resistance. No failure has occurred since.

Six of the large mines covered by *Coal Age* use asbestos-insulated cables for rewiring all d.c. machinery. Several other companies use it in part. For instance, cutters only are so wired at Continental No. 4, and locomotives only at Eagle mine. Asbestos-covered magnet wire is specified for new field coils purchased by the Louise Coal Co. Glass insulation is being tried in the armatures of two CY-21 reel motors at Maiden mine. The Pursglove company has a glass-insulated armature in use in a 35B shortwall and is buying only that type of coils for future rewinds of 35B and 35BB armatures.

All mines surveyed use rubber-sheath trailing cables, and the parallel-duplex type for loaders and cutters is preferred. No. 1/0 is the largest size in use (on Sullivan 7AU cutters at Robinson Run No. 2 and the Mona mine, Arkwright Coal Co., both in Monongalia County). Lengths of 250 and 300 ft. are the most common, but lengths up to 500 ft. are in use. Dawson No. 2 mine, Dawson Coal Co., Harrison County, 550 volts d.c., uses Size No. 3 single cables 500 ft. long on the 6-ton locomotives which service the loading machines. Size in this case is governed by breaking strength rather than carrying capacity, this because the current is half what it would be with 275 volts. No. 3 concentric is used by this company on Goodman 260B loading and Jeffrey 29U cutting equipment.

No. 2 concentric 450 ft. long is used on loaders, cutters and flameproof gathering locomotives at Federal No. 1. These cables are repaired and full lengths are built up from used pieces in a vulcanizing shop recently set up in an outlying surface substation where an attendant is on duty. Cable vulcanizing also is the practice at Continental No. 4. Cables are removed when they accumulate eight to ten temporary splices and rebuilding with vulcanized joints is done in a shop near the tipple. At the time of this survey the Christopher Mining Co. had ordered a Mines Equipment Co. vulcanizer of the same electric-heated-steam type as used at the other mines in the district.

The general rules for proper maintenance of batteries on the rubber-tired shuttle cars used at several northern West Virginia mechanical mines do not differ from those which apply to locomotive batteries. The charge to be given a battery is predetermined by taking a gravity reading and setting the pointer of the controlling meter to the number of ampere-hours indicated by a table posted in the charging station. Table I was made up from the charts used at the Laura Lee mine, Hutchinson Coal Co., Harrison County, and Consolidation No. 25 mine, where the batteries are Exide-Ironclad and Philco, respectively. Automatic action of the ampere-hour meter in No. 25 is this:

Table I—Charging Instructions for Batteries for Rubber-Tired Shuttle Cars

Specific Gravity Of Battery	Set Ampere-Hour Meter at: 48-TLM-9 Exide-Ironclad[1]	XL-13 Philco[2]
1275	0	....
1270	10	20
1260	20	40
1250	35	60
1240	50	80
1230	65	100
1220	80	120
1210	95	140
1200	110	165
1190	125	185
1180	140	205
1170	150	225
1160	165	245
1150	180	265
1140	195	290
1130	210	330
1120	....	350

[1] Once a week give an equalizing charge by setting ampere-hour meter ahead an additional 50 amp.-hr.

[2] Every six or seven charges set ampere-hour meter 25 points additional.

Table II—Dollars of Supply Inventory Per Ton of Production Per Shift

Mine No.	Number of Shifts Worked Per Day	Total Inventory, Including Rails and Timber	Inventory of Repair Parts and Supply Items (Not Including Rails and Timber)
1	3	$32.00	.....
2	1	6.80	.....
3	3	17.20	.....
4	2	13.60	.....
5	2	7.10	.....
6	2	20.00	.....
7	3	.....	$13.50
8	3	.....	8.20

This inclosed rotating bin with locking doors in Federal No. 1 supply house has pockets for 250 "sticky" items.

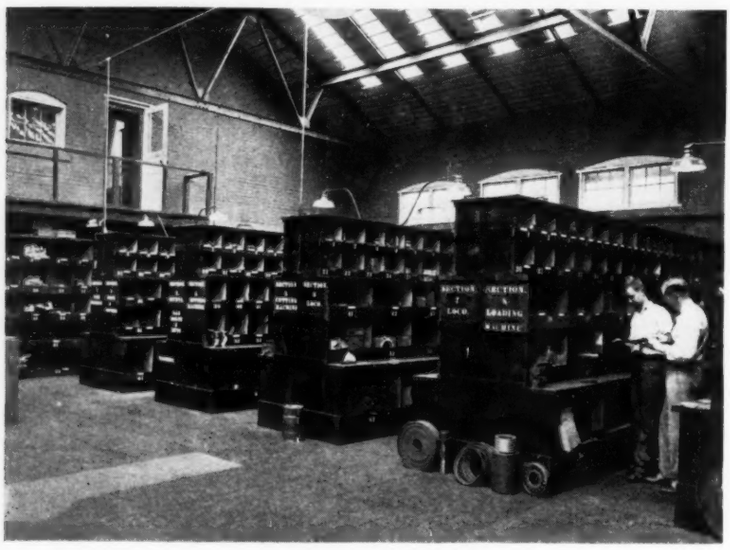
At 50 amp.-hr. less than full (330-amp.-hr. batteries) the charge is reduced to 15 amp. Then, when both batteries being charged from the one 10-kw. 132-volt motor-generator set are full, the set is shut down. In reporting battery maintenance and performance Consolidation uses the standard form adopted some years ago for battery locomotives. The headings of two columns "Motorman" and "Loco. No." are changed to "Shuttle-Car Operator" and "Shuttle-Car Number." Batteries in all cases are handled by swinging roof-jack cranes equipped with Coffing ratchet hoists.

Making "Megger" tests of insulation resistance and recording these results in graphic form on cards kept individually for the principal items of electrical equipment has proved a valuable tool in forestalling breakdowns and keeping electrical equipment in safe condition at the Federal mines.

Close proximity to many supply houses, such as those in Clarksburg, Fairmont, Morgantown, Wheeling, Pittsburgh and Johnstown, permits northern West Virginia mines to hold total mine-supply inventories to low figures considering the greater amount of machinery that must be maintained and in comparison with past years when transportation was not so rapid. That some of the equipment factories (Jeffrey at Columbus; Joy at Franklin, Pa.; and Westinghouse at Pittsburgh, as examples) are also relatively close to the district helps the situation. Table II sets forth supply inventories per ton of shift production at eight mines, both large and small, in the district, selected at random. The average for six mines for which total inventory figures were available is $16 per ton of shift production.

Supply houses in charge of supply clerks and using perpetual-inventory systems are maintained at Continental No. 4, Federal No. 1, Federal No. 3, Jamison Nos. 8 and 9, and Maiden. A supply house in a brick building attached to the mine office at Jamison No. 8 is notable from the standpoints of bin spacing, lighting and orderly arrangement. Receipts and disbursements are posted daily on all cards affected. Supplies are grouped according to machine or use and the cards show the section and bin location. A complete physical inventory is made once a year, but frequent checks of many items of stock are made against the card balances.

The supply house at Federal No. 3 mine is equipped with steel bins and those in the background are of the rotating type.



Spacious and orderly supply house at Jamison No. 8.

Bin Shelves Rotate

Steel bins are used at the Federal mines and these include at each mine several of the "Rota-bin" units made at Wellston, Ohio. One bin with its ten rotating shelves can be fitted with partitions to make 250 pockets, each of sufficient size, for the total supply of many small items. The Federal No. 3 supply house has eight "Rota-bins" and Federal No. 1 has seven. One of the latter is of the inclosed type with locking door for small "sticky" items. Mine supplies are divided into 26 classes and at Federal No. 1, the larger, items total 5,000 and the cards recording these are filed in eight "Visulizer" books. A complete physical inventory is made once a year and in addition once a month during the intervening time there is made one of eleven inventories into which the classes are grouped.

None of the mines of the district carries a large quantity of supplies underground. As a rule the total consists of emergency parts of small size stocked in the mine-electrician's room or in the underground shop. Emily mine will be the exception when present plans to build a supply house underground are carried out. At mines where the chief electrician is responsible for maintaining his stock of repair parts he usually checks his stock by visual inspection of bins and trusts his memory as to how many items of a kind should be carried. At Dawson No. 2 mine, the chief electrician and mine superintendent share the responsibility and once a month the two of them make an inventory to determine what parts to order.

VENTILATION

+ At Northern West Virginia Mechanical Mines

NATURAL conditions affecting ventilation at the mechanical mines in the Fairmont field of northern West Virginia range from gaseous deep workings to areas surrounded by outcrop and devoid of gas. Protecting face crews against "stinkdamp" (H_2S) has required extra supervision of air control in one of the large operations. Three mines are served by propeller fans of the streamlined type. Volumes and pressures over the field range from 40,000 c.f.m. at ½ in. w.g. to 300,000 at 4½ in. Three of the shaft mines have auxiliary power for emergency fan operation.

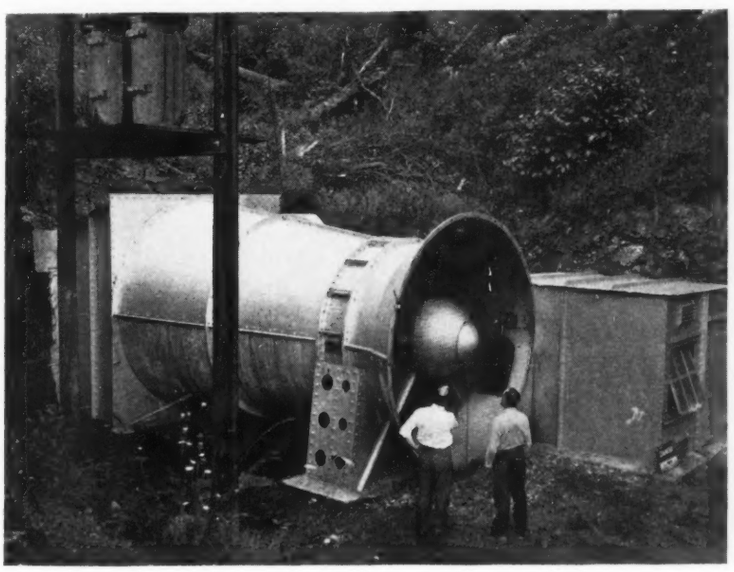
Three slope and four shaft mines are included in the list visited by *Coal Age*. Eight are considered very gaseous, two show some gas, and the rest are non-gaseous in so far as detectable quantities are concerned. Fans at twelve mines operate exhausting, and at eight, blowing. Main haulage is on the return in five mines. Number of splits usually is two or three, but in one mine using 44,000 c.f.m. there is no split and in another 160,000 c.f.m. is split five ways. Overcasts per mine range from zero to ten, main doors from zero to twelve, and several mines use automatic doors as air locks on the main hauls.

Four of the mines studied are in the Sewickley seam, ranging from 4 to 6½ ft. in thickness. The remainder recover 5½ to 7½ of the 6½- to 9-ft. Pittsburgh seam, where a foot or more of top coal usually is left in place. At all but a few operations, openings usually are driven 12 to 14 ft. wide on 80- to 100-ft. centers to divide the coal into blocks, which normally are mined immediately.

Although a drift operation, Maiden mine of the Kelleys Creek Colliery Co., in Monongalia County, encounters considerable gas, and the worked-out sections must be bled to the main return. Two years ago, as a means of increasing the volume of air, an 8-ft. Jeffrey Aerodyne fan was installed near the haulage portal to replace an Aerovane unit. Present volume is 120,000 c.f.m. and the pressure 3.2 in. The fan operates blowing but the main haulage is made an intake by means of a pair of Canton automatic doors forming an air lock near the portal. Drive consists of a Westinghouse 75-hp. 900-r.p.m. 440-volt Type CS induction motor with the typical V-belt connection. Nine overcasts are used in the mine and stoppings for permanent duty are built of cinder-concrete blocks made waterproof to reduce air leakage. Eight 12-ft. headings as a rule, but in some places six, constitute the main entries. Ventilation is divided into three splits.

Robinson Run No. 2 mine of the Christopher Mining Co., a drift operation in Monongalia County opened in June, 1938, and now producing 5,500 tons per day, three shifts, liberates considerable methane and one section when being developed emitted stinkdamp (hydrogen sulphide, H_2S) so freely that air circulation had to be increased to prevent discomfort to the eyes of men at the face. This mine also is ventilated by an 8-ft. Aerodyne fan near the haulage portal. It is directly across the

Two years ago, Kelleys Creek installed this "streamliner" at Maiden mine to replace a 1930 model fan.



AIR ANALYSIS REPORT

Date_____19__

CHRISTOPHER MINING CO. Mine_____ Mine Working Today

No.	LOCATION	Area	Velocity	Volume	CO_2	O_2	CH_4	Cu. Ft. CH_4 Per Min.
1								
2								
3								
4								
5								
29								
30								
31								
32								
33								
34								
35								

Fan Fan, Speed R.P.M. W. G. Inches, Total Air Total Ch.

Barometer Outside Temp.

Method of Analysis By

Safety Director

road from the mine-rescue station in the shop, supply and office building in which the safety director has a laboratory for gas analysis. Maximum rating of the fan is 1,000 r.p.m., 165,000 c.f.m., 3-in. w.g. At present it is operated at 575 r.p.m. and delivers 131,000 c.f.m. at 1.6 in. The drive is a General Electric 30-hp. 440-volt motor.

Greatest liberation of the hydrogen sulphide—often spoken of as sulphureted hydrogen—occurs under a binder 7 ft. below the top at Robinson Run No. 2. No effect was noticed on breathing, but small quantities caused eye discomfort and inflammation. A peculiarity is that while very small concentrations offer a striking odor to one coming from fresh air, the olfactory organs become insensitive to the gas in a very short time even if the concentration is enough to quickly cause eye difficulties. Protective measures include checking with an M.S.A. H_2S detector which will indicate to 0.0001 per cent. Air quantities were increased to hold percentages in working places below 0.0075 per cent, which, however, still was enough to smell strongly when first encountered.

In handling methane at Robinson Run, the safety engineer makes a complete air report once a week, which includes results of analyses of samples from each split, from the last working place of each section, and from the main return. An M.S.A. detector is taken along as a quick check when collecting samples with the gas bags for laboratory analysis. Methane in the main return sometimes reaches 0.50 per cent. The mine is ventilated with three splits, with the first 1,800 ft. from the fan. Although there are five intakes (one shaft and four drifts), the air in one split travels 4½ miles. Four overcasts are in use and the total number of doors, including two main doors forming an air lock, is nine. The fan at this mine is equipped with a pressure switch which causes the substation breakers to open and cut all d.c. power from the mine if the fan pressure drops as much as 0.5 in.

Overcasts are built for $90 each at Dawson No. 2 mine, using concrete blocks for walls, roof joists of 45-lb. rail on 17-in. centers, and 5x8x16-in. cover tiles.

Ventilation at Federal No. 1, a shaft operation of the Koppers Coal Co. in Marion County, is unusual in that for a number of years it has been the largest producing mine in West Virginia and yet no change in fan speed has been made since 1928. By digging an airshaft back on Finche's Run and maintaining airways to reduce resistance, no increase of fan power has been necessary. The present fan, a Robinson 11½x7-ft. double-inlet backward-curved-blade centrifugal unit, was installed eleven years ago and was outstanding in its day because it was fitted with a slow-speed direct-connected induction motor, thus eliminating the maintenance and power loss incident to a gear, chain or belt drive. The motor is a General Electric 28-pole 2,300-volt wound-rotor unit rated 350 hp. at 257 r.p.m. Insurance against complete interruption of ventilation by failure of the large motor or of purchased power consists of a 200-hp. 900-r.p.m. motor and reduction gear which can be connected to the other end of the fan shaft through a Falk flexible coupling from which the spring connection normally is omitted. The emergency 2,300-volt power supply consists of a Sterling gasoline engine direct-connected to a generator made from a 300-hp. synchronous motor.

Federal No. 3, in Monongalia County, is a drift mine, but much gas is encountered. A centrifugal fan near the main portal and driven by a 150-hp. motor circulates 130,000 c.f.m. against a 3-in. water gage. Two Canton automatic doors are installed not far inside the portal and the haulway is on the intake. An airshaft 2 miles from the portal cuts air travel, yet the longest split is 7 miles. The current is on four splits. Eight overcasts are in use and the total number of doors is 21, includ-

ing six units classed as main doors.

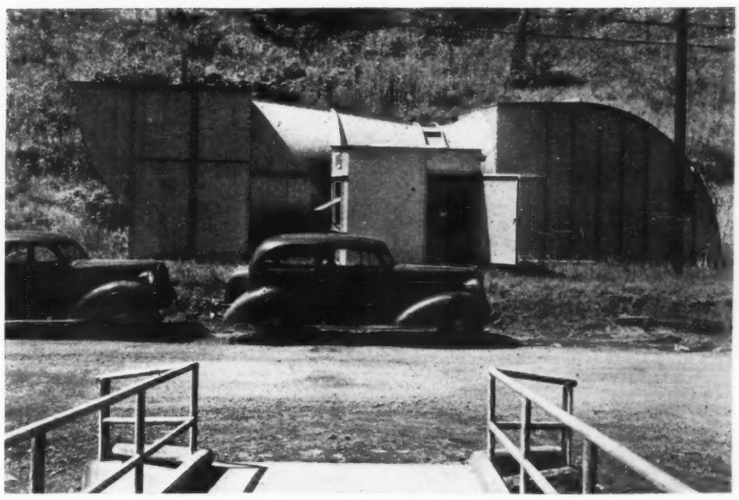
Two shaft mines of the Jamison Coal & Coke Co., Nos. 8 and 9, in Marion County, are similar in most features bearing on ventilation. Centrifugal fans at man shafts near the tipples operate exhausting. One at No. 8 pulls 180,000 c.f.m. at 3.3-in. w.g., while No. 9 fan handles 140,000 c.f.m. at 2.3 in. Intakes at each mine are the hoisting compartment of the man shaft and the three compartments of the hoisting shaft. Methane in the main return averages 0.20 per cent. Auxiliary power units consist of Sterling gasoline engines and 90-kw. 2,300-volt generators.

In Continental No. 4, Continental Coal Co., a Sewickley-seam slope operation in Monongalia County producing 2,500 tons, single shift, airways are being cleaned and widened with a loading machine. Seven hundred feet had been completed at the time of this survey. The next step will be to drive two additional airways for a distance of two miles. Three years ago an escape shaft was excavated at a point 3½ miles (mine distance) from the fan, which is near the tipple. This shaft serves as an intake. A centrifugal fan driven by a 200-hp. motor exhausts 160,000 c.f.m. from the mine at a 3-in. w.g. and the main return contains 0.18 per cent methane. The air is divided into five splits. Eight overcasts have been built in the mine and twelve main and auxiliary doors are in use.

Air Rooms Driven

In Mona mine of the Arkwright Coal Co., in Monongalia County, all rooms of a panel except No. 1 are turned 60 deg. to form diamond-shaped blocks. To act as an airway and also to facilitate drainage, No. 1 room is turned at 90 deg. and is driven through to the next panel entry. At this mine the fan is at an outcrop opening near the center of the property, which is one of five crop openings serving ventilation. The air supply is 60,000 c.f.m. at ½-in. w.g.

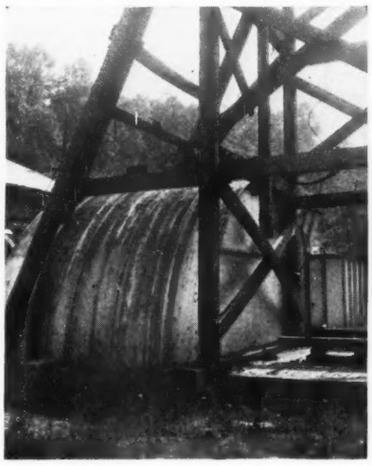
Two blowing fans at airshafts at the back ends of the two working sections operate in parallel to ventilate Pursglove No. 15 mine of the Pursglove Coal Mining Co., Monongalia County. Total air is 186,000 c.f.m. and the methane content ranges from 0.2 to 0.3 per cent. Pressure against one fan is 2.4 in. and the other 1.75 in. The mine contains four overcasts and fifteen doors, although there is not a single door on the main haulageway, approximately 4 miles long. Pursglove No. 2, a drift mine, has one blowing fan at a 200-ft. airshaft 2 miles from the haulage portal. Circulation is 95,000 c.f.m. and the return contains 0.10 to 0.15 per cent methane.



Looking out of the door of the mine-rescue and gas-analysis room at the streamlined fan ventilating Robinson Run No. 2 mine.

Overcasts in Dawson No. 2 mine of the Dawson Coal Co., Harrison County, have cost only $90 each. Nine have been installed and no main doors are required. Walls are built of concrete blocks and the top is 5x8x16-in. tile supported by 45-lb. rails on 17-in centers. The mine top is taken down to the checker rock, thus providing a space 4 to 7 ft. over the tile. Approach corners are filled, with the toe of the fill extending 9 ft. from the wall. In contrast to the general practice in the district of using cinder-concrete or limestone-concrete blocks, the same 5x8x16 tile are used in Dawson for stoppings. When set without mortar between, but with the joints pointed on each side, the individual tiles are easily recovered for use in a new location. This mine is free of gas but the low ends of room entries are sealed with 12-in. concrete dams put in principally to protect the main headings from water. The mine fan, which operates blowing, is an 8-ft. straight-flow unit and circulates 86,000 c.f.m. at ½-in. w.g.

Resistance is reduced by the curved housing connecting airshaft to fan at Pursglove No 15 mine.



In Emily mine of the Monongahela Rail & River Coal Corporation, Monongalia County, all stoppings in the mine are identified by large painted numbers and these corresponding numbers appear in red pencil on the stoppings of a 50-ft.-per-inch map of the entire main haulway, which map is mounted on the wall in the mine office. The object is quick identification of location in combating fire or other emergency. The large-scale map consists of photostatic enlargements from the regular mine map. Emily is not troubled with gas and the main current is not split. A centrifugal fan operating exhausting and driven by a 50 hp. 2,300-volt motor supplies 44,000 c.f.m. at 1¼ in. Emily is a drift mine but the only crop openings are the haulway and the fan drift 700 ft. away.

Rachel mine Jones Collieries, Inc., Marion County, is served by shafts 365 ft. deep, but only a relatively small quantity of gas is encountered and the main return carries 0.05 per cent. A 4½x10-ft. Sirocco exhaust fan at a 12-ft.-diameter circular airshaft near the tipple handles 110,009 c.f.m. at 2¾ in. The main current is split 4,500 ft. from the bottom and the round-trip travel in the longest split is 5 miles. The mine has eight overcasts and no doors are used on the main haulways.

PUMPING AND DRAINAGE

+ At Northern West Virginia Mechanical Mines

SPRING months bring drainage worries to several of the mechanical-loading mines in the Fairmont field of northern West Virginia, but only two or three operations are bothered by much water throughout the year. Acid concentration is high in half the mines and pumps of special bronze or chrome alloy are used, with suction, discharge and borehole lines of asbestos, fiber, wood or protected steel. In one mine, with the usual sulphur balls characterizing the region, the water is alkaline. The deepwell-type mine pump has been introduced and four mines now have automatic priming and control of one or more underground pumping stations.

Pump-motor sizes range from the typical 3- to 5-hp. d.c. units on gathering pumps to 150-hp. for the largest centrifugal pump in a main underground station. One to three main stations discharging to the outside is the typical layout but there are five at one mine, Pursglove No. 15, Pursglove Coal Mining Co., in Monongalia County. On the other hand, Dawson No. 2 mine, Dawson Coal Co., Harrison County, is self-draining to the outside and the entire pumping equipment consists of five Fairmont gathering pumps with bronze cylinders and Monel pistons. Water from pillar workings is medium acid and the balance apparently is neutral—locally termed "fresh." Plain steel pipe only is used in this mine. The mine also makes extensive use of dams, or bulkheads, and these serve incidentally as air seals. They are placed at the downgrade end of room entries to protect the butt headings. Construction is concrete 12 in. thick.

Before moving on to a description of a few of the largest pumping stations and anti-acid problems it appears in order to mention here one other mine which has no main pumps. Practically all of the water from Louise mine of the Louise Coal Co., in Monongalia County, seeps away into the worked-out Jere mine, which is adjacent. The same financial interests get the water, however, because it goes on through the fireclay bottom (Sewickley seam) into Bunker, of the Davis-Wilson Coal Co. Bunker has numerous sulphur balls but the water is alkaline. This condition results, it is believed, from the fact that the Jere water is sufficiently alkaline to neutralize any acid that forms in Bunker. Jere no doubt contains much sulphur but it is accepted that when mine workings are full of water and all air is excluded the water should be alkaline even though pyrites be present.

Three Pumps to Outside

Maiden mine, a drift operation of the Kelleys Creek Colliery Co., in Monongalia County, has three pumping stations delivering to the outside and in the one at First East borehole the pump is driven by a 150-hp. 2,300-volt motor. The pump is a Morris single-stage 8-in. 1,250-g.p.m. unit with bronze casing and chrome-alloy impeller. Near by is a 500-g.p.m. Scranton single-stage unit of the same construction driven by a 40-hp. 440-volt motor. Boreholes are 8 in. in diameter and 182 ft. deep. Goodrich rubber-lined pipe is used in each case for the bottom connection. The smaller pump starts and stops automatically.

At the "Mains" borehole in Maiden mine the dewatering unit consists of a Manistee 800-g.p.m. single-stage all-chrome pump driven by a 100-hp. d.c. motor. This hole is 8 in. in diameter, 198 ft. deep and, like the others, is bottomed with a length of rubber-lined pipe. No intermediate or relay pumps are used but the gathering equipment consists of ten piston pumps and seven 2½-in. 400-g.p.m. self-priming Duraloy centrifugals driven by 15-hp. d.c. motors.

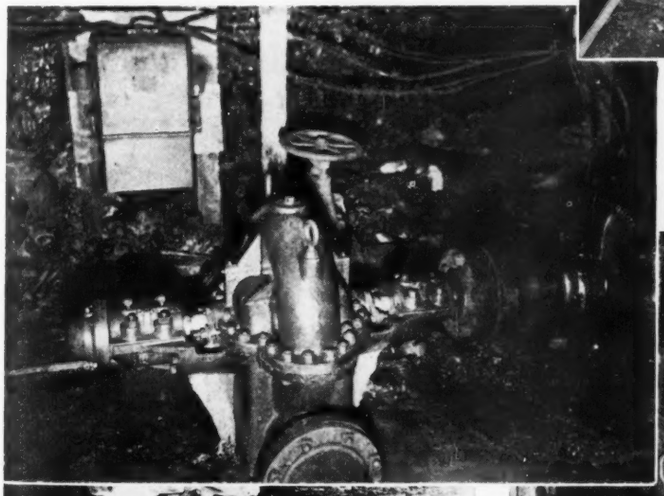
Water enters the mine mostly through springs in clay veins but a considerable quantity also originates in pillar breaks. The former is fresh water but the latter is highly acid. Maiden mine also operates the deepwell turbine pump mentioned above—a Pomona water-lubricated unit rated at 450 g.p.m. and driven by a 20-hp. Westinghouse 440-volt motor. Hole depth is 107 ft. and the column is copper-content steel pipe with enamel lining. Starting is manual but the stopping is handled automatically by a Mercoid switch moved by a vane in the discharge pipe. This vane operates the switch when the flow drops to half normal and it would serve to protect the pump.

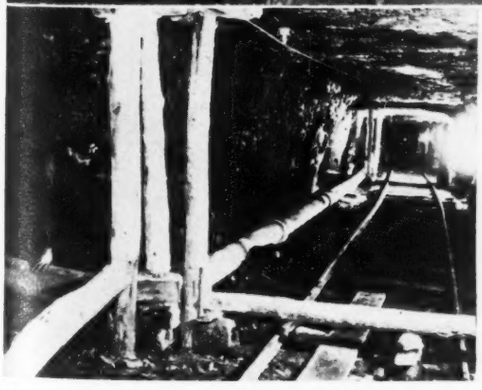
Pursglove No. 15 makes a large quantity of highly acid water. Principal pumps discharging to the outside are: Bertha borehole, 130 ft., Warren 1,200-g.p.m., bronze casing, chrome impeller, and a Scranton 800-g.p.m., bronze casing, chrome impeller (both driven by 50-hp. 440-volt motors); Myers borehole, 230 ft., Deming 450-g.p.m., bronze and chrome, by a 40-hp. 440-volt motor; Homer Bell borehole, 230 ft., Morris 1,000-g.p.m., bronze and chrome, 100-hp. 440-volt motor; airshaft, 250 ft. deep, Morris 1,500-g.p.m., all chrome, 100-hp. 440-volt motor. All other dewatering units in the mine are classed as gathering pumps and consist of fifteen reciprocating-type Murrays and Demings, driven principally by 7½-hp. d.c. motors. Two hundred feet of 6-in. Transite pipe

This deepwell turbine pump, which dewaters a section of Maiden mine, is stopped by the mercury switch connected to a vane in the discharge connection (right).

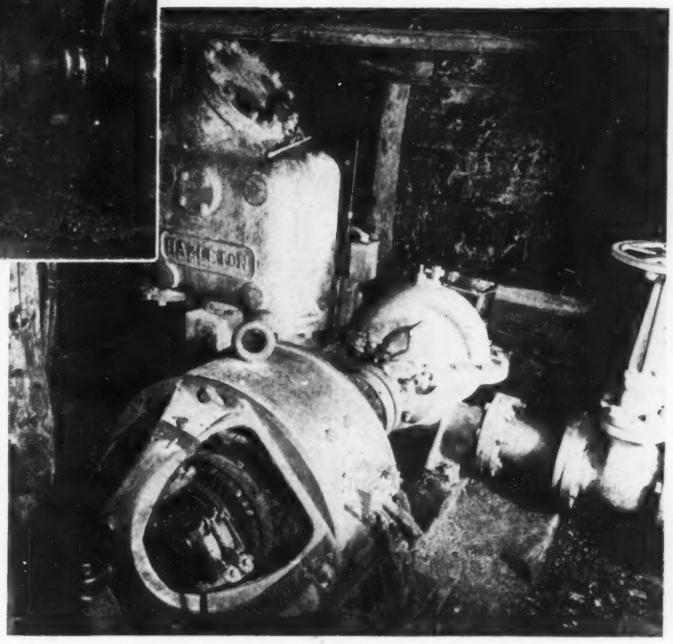
Above—Wood pipe in foreground connecting to a fiber pipe which lines the borehole—Emily mine.

Left—This 1,500-g.p.m. all-chrome centrifugal pump in Pursglove No. 15 mine discharges through a 250-ft. airshaft.

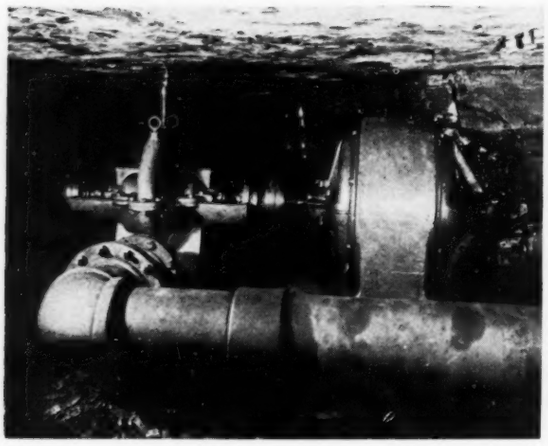




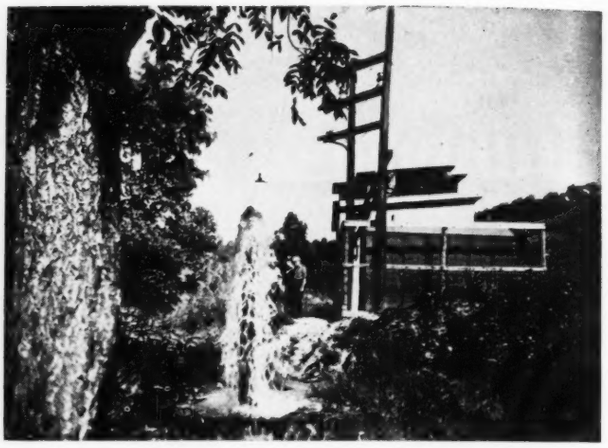
Timber anchorage of a 90-deg. turn in a 1,000-ft. length of 8-in. asbestos-cement pipe serving as the discharge from a 1,000-g.p.m. intermediate pump in Mona mine.



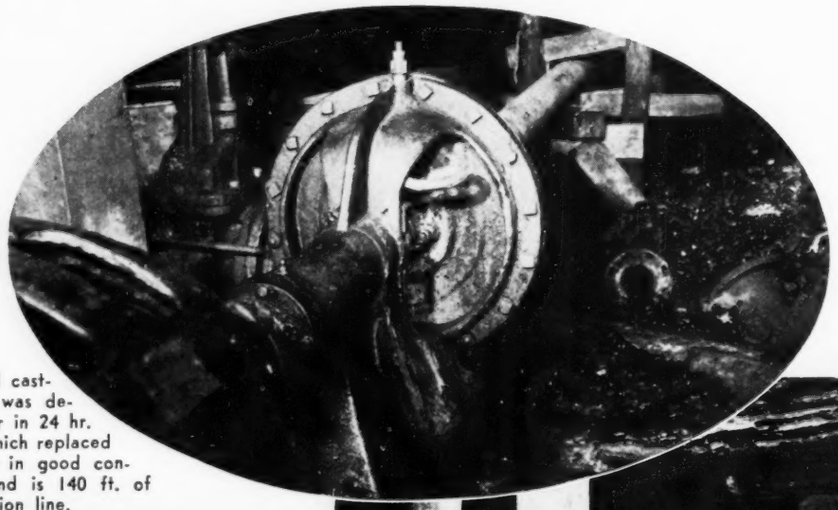
In Mona mine this 750-g.p.m. all-chrome pump is controlled automatically by auxiliaries consisting of a primer, float switch and contactor starter.



At Bunker mine this 2,500-g.p.m. bronze-fitted centrifugal driven by a 100-hp. 440-volt motor discharges through the main slope against a 165-ft. total head.

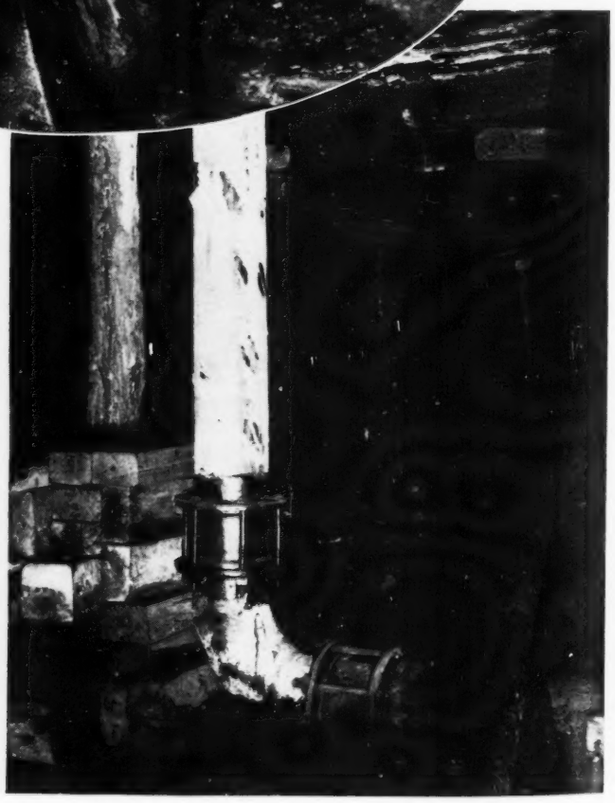


This water, discharging from a 146-ft. borehole at Robinson Run No. 2, is pumped by a 500-g.p.m. all-chrome centrifugal.



In Emily mine the original cast-iron case of this pump was destroyed by the acid water in 24 hr. The chrome-alloy casing which replaced it four years ago still is in good condition. In the background is 140 ft. of 4-in. asbestos-cement suction line.

Water at Rosedale mine is high in acid but has had no effect on this 1,200-ft. length of 4-in. asbestos-cement pipe.



Wrapped-and-lined steel pipe lines this borehole recently completed at Emily mine.

constitutes the discharge line from the Deming 450-g.p.m. main pump to the borehole and some 3-in. Transite pipe is used on gathering pumps.

Pursglove No. 2, in the Sewickley seam, is not troubled with acid and apparently part of the water drains down into the No. 15 workings in the Pittsburgh seam below. From the Sewickley, three centrifugals with capacities of around 500 g.p.m. each deliver to the surface through boreholes. Gathering equipment consists of twelve Deming piston pumps with 7½-hp. motors.

Water is highly acid in the Mona mine, Arkwright Coal Co., Monongalia County, and the newest unit is an all-chrome Warren 1,000-g.p.m. pump delivering against a 65-ft. head through a drift to the outside and controlled automatically by a Hazleton primer, float switch and Ohio Brass d.c. automatic starter. The other pump to the outside, also delivering through a drift, is a 375-g.p.m. all-bronze unit. Another 1,000-g.p.m. all-bronze centrifugal serves as an intermediate. Ditches drain to its sump and there are no gathering pumps in the mine. The intermediate-pump discharge consists of 1,000 ft. of 8-in. Transite and 600 ft. of Wyckoff woodstave pipe. Each pump has a short suction line of Ace hard rubber and the gate valves are lined with the same material. Present workings are being driven to hit a 110-ft. borehole to which the Warren chrome pump will be moved. All three pumps are driven by d.c. motors and the largest is 30 hp.

Pipe Is Non-Corrosive

Twelve hundred feet of 4-in. Transite and 350 ft. of 3-in. serve as discharge lines in Rosedale mine, Rosedale Coal Co., Monongalia County. These pipes discharge to ditches leading to drift openings. Pressure therefore is low and the lines need not be anchored to hold the joints in place. One 20-hp. centrifugal pumping unit discharges to the surface through an 82-ft. borehole.

Bunker mine, mentioned as getting water from Louise mine by way of worked-out Jere mine, and where the water is alkaline, has a 100-hp. 8-in. 2,500-g.p.m. Weinman centrifugal unit at the bottom of the slope. Another Weinman centrifugal (4-in.) serves in the same station, principally as a standby. Seven 4x5-in. plunger pumps act as gatherers and two 3-in. centrifugals relay water to the main stations.

When the water gets low in the sump in Robinson Run No. 2 mine, Christopher Mining Co., Monongalia County, the acid concentration becomes high, but the possibility of this condition was foreseen and a Duraloy pump was installed. It is a Weinman 500-g.p.m. single-stage 40-hp. d.c. unit working against a 146-ft. head. Its discharge borehole, cased with 6-in. asphalt-lined pipe, is 6,000 ft. from the main portal and within 50 ft. of an Ignitron-type substation on the surface. The pump operates "submerged"—that is, at "high tide" in the sump back of a dam the level is even with the top of the case.

Emily mine, Monongahela Rail & River Coal Corporation, Monongalia County, gets water of high acidity from pillar breaks and old workings and it is believed that some of this water comes from old workings in the Sewickley seam some 90 ft. above. Water is discharged through two boreholes, both 120 ft. deep. One, five years old, is lined with Bermico, and the other, a recent installation, is cased with wrapped-and-lined steel pipe (Youngstown Sheet & Tube Co.). At one borehole the pump suction is 140 ft. of 4-in. Transite and the discharge connection to the borehole is 30 ft. of 6-in. Transite pipe. At the other station, the suction is 30 ft. of 6-in. Transite and the discharge to the bottom of the borehole is 550 ft. of 6-in. Wyckoff wood pipe.

One of the Emily pumps is a Deming 5-in. 550-g.p.m. unit of Duraloy-A construction. This Duraloy pump has been in use four years and shows no sign of corrosion. A cast-iron case on the pump originally installed in this location lasted only 24 hours. The other pump, working where the water contains less acid, is a Weinman 3-in. centrifugal unit with bronze case and impeller. Considerable ditching is done in the mine. One drainway 1,500 ft. long includes several hundred feet of 8-in. sewer tile. One intermediate pump was eliminated by a 600-ft. ditch which is 3½ ft. deep in some places.

Although 21 small gathering pumps work in Continental No. 4 slope mine of the Continental Coal Co., in Monongalia County, only one 500-g.p.m. unit delivers to the outside because most of the water runs to the abandoned north side of the mine, which is being allowed to fill. However, it is planned in the near future to drill a hole and install a deepwell-turbine pump to handle water from this section. For intermediate duty, two 4-in. Weinman centrifugals work in series 2,000 ft. apart. The water is not very corrosive but recently a 700-ft. line of 6-in. wood pipe was installed.

Recently a full-automatic pumping station was installed in Federal No. 1, a shaft operation of the Koppers Coal Co. in Marion County. The pump is a Weinman 4-in. two-stage all-bronze unit driven by a 75-hp. d.c. motor. A Hazleton primer and an Allen-Bradley starter perform the automatic functions. All wiring is installed in rigid conduit. Three other principal pumping units, maximum size 75 hp. and maximum head 400 ft., operate in this mine. In contrast to Federal No. 1, Federal No. 3 mine, Monongalia County, makes water which is highly acid. Therefore, considerable 4-in. Transite pipe is used. One Weinman three-stage all-bronze centrifugal driven by a 75-hp. 2,300-volt motor and discharging through a 230-ft. airshaft constitutes the main pumping station. Other equipment consists of three intermediate and eleven gathering pumps. Allen-Bradley starters are used on all pumps in this mine as well as in Federal No. 1.

Breaks Are Dry

In Nos. 8 and 9 mines of the Jamison Coal & Coke Co., both shaft operations in Marion County, the water is non-corrosive unless it is allowed to accumulate. In No. 9, which has the less water, the new headings encounter a small influx, but once pumped they remain dry. Seldom do pillar breaks let in any water and the supposition is that silt seals them quickly. At No. 9 two pumps discharge to the outside and at No. 8 three perform that duty. Motors on the largest pumps in the two mines are 75-hp. 275-volt d.c. and 40-hp. 220-volt a.c. respectively. No. 8 is equipped with a 250-g.p.m. intermediate pump and six small gathering pumps.

Limited quantities of non-corrosive pipe, wood in each case, are used by certain mines not already mentioned, including Rachel, Jones Collieries, Inc. (Marion County), and Laura Lee, Hutchinson Coal Co., and Eagle, Getty Coal Co., in Harrison County. One section of the Eagle mine drains by gravity to crop openings, but the other requires considerable pumping from pillar sections in wet weather. The small quantity of water handled during the dry season becomes highly acidulous. Four Fairmont 3-hp. bronze-fitted gathering pumps and three 10-hp. all-bronze centrifugals comprise the equipment used for handling water underground.

FAIRMONT COALS

+ Show Minor Long-Term Shifts

COALS from the northern West Virginia field enter into all classes of industrial uses and have a wide geographic distribution. Both the exacting requirements of the byproduct and metallurgical markets and the more varied and changing demands of general industry can be satisfied by some mines in this district. While strictly household, or domestic, fuel has not loomed as large in the Fairmont field as in some of the coal-producing districts farther west and south, this market is by no means ignored.

In discussing the technical developments which have made this district outstanding, the detailed studies presented in preceding pages of this issue of *Coal Age* have dealt only with mechanized operations in five of the counties in the northern part of the State. These counties are: Barbour, Harrison, Marion, Monongalia and Taylor. The distribution data incorporated in this particular presentation however, cover all the counties included in District No. 3 as defined and outlined in the Bituminous Coal Conservation Act of 1937. Production and shipments of both mechanized and non-mechanized mines enter this distribution picture.

Railroads as a group constitute the largest customer of the northern West Virginia producers. Railroad fuel purchases in recent years have exceeded war-time figures both in actual tonnage and in the percentage of the total output of the district absorbed. In 1917, for example, the railroads took 5,862,206 tons, or approximately 33.6 per cent of the northern West Virginia coal consumed in the United States. Twenty years later the volume had risen to 7,869,413 tons and the proportion of the total tonnage (exclusive of exports) to approximately 38.3 per cent (see Table I). A substantial part of these purchases was for off-line fuel consumption.

The greater part of the commercial tonnage of Fairmont coals moving all-rail to destination goes to markets in the area east of the Indiana-Ohio State line and south and east of the Great Lakes. As in the case of railroad fuel, 1929 was the year of heaviest tonnage. Unlike the railroads, however, 1937 shipments to the New England and Middle and South Atlantic States (New Jersey, New York and Pennsylvania; Delaware, Maryland, District of Columbia, Virginia, West Virginia, the Carolinas, Georgia and Florida) were slightly under 1918 totals but in excess of shipments to these same markets in 1917. This broad area of distribution accounted for 39.1 per cent of the total movement (exclusive of exports) for northern West Virginia that year. In 1937, the figure was 38.2 per cent.

As is shown statistically in Table I, there has been a distinct falling off during the past twenty years in the tonnage of Fairmont or northern West Virginia coal shipped to tidewater. The percentage of northern West Virginia coal going into that market has shrunk from 15.4 per cent of the total movement of Fairmont district coal (exclusive of all-rail exports) in 1917 to 4.6 per cent in 1937. Lake movement, on the

Table I—Shifts in Northern West Virginia Distribution

	1917 Tons	1918 Tons	1929 Tons	1937 Tons
New England and Atlantic States	6,972,926	8,068,672	10,755,965	7,865,392
Ohio	532,000	208,402	2,532,393	*1,683,338
Illinois-Indiana	90,000	31,751	123,489	214,790
Michigan	261,000	198,445	159,250	202,379
Wisconsin	.....	4,736	5,861	6,640
Minnesota	.....	.....	4,464	1,034
Iowa	.....	.....	10,954	9,460
Tidewater	2,699,242	3,741,539	2,168,568	950,007
Lakes	1,029,201	1,330,949	1,510,431	1,748,059
Railroad Fuel	5,862,206	6,864,777	9,996,179	7,879,413
Totals	17,437,575	19,949,271	†27,267,554	20,550,512

* Exclusive of Youngstown area in 1937; included in New Enlgland and Atlantic States.
† Includes 3,502 tons to Kansas, Missouri, Nebraska and South Dakota.

Table II—Size Distribution

All-Rail Shipments

Size Group*	Tons	Per cent
1	738,768	8.332
2	733,586	8.274
3	617,120	6.960
4	1,122,695	12.663
5	1,754,317	19.786
6	1,885,796	21.269
7	2,014,085	22.716
Total	8,866,413	100.000

Tidewater

1	13,099	1.379
2	27,929	2.942
3	11,501	1.211
4	32,658	3.440
5	361,664	38.095
6	70,356	7.411
7	432,379	45.522
Total	949,379	100.000

Lake Shipments

1	24,833	1.429
2	143,417	8.251
3	87,749	5.048
4	109,455	6.297
5	28,537	1.642
6	46,878	2.697
7	221,554	12.747
8	16,897	0.972
9	512,007	29.458
10	312,083	17.955
11	234,712	13.504
Total	1,738,122	100.000

* The size groups, as defined in the Schedule of Proposed Minimum Prices for District No. 3 (*Federal Register*, June 29, 1939), are as follows:

1. Lump coals larger than 2-in.; double-screened egg with bottom sizes larger than 2-in.
2. Lump coals larger than 1¼-in. but not exceeding 2-in.; double-screened egg with bottom sizes larger than 1¼-in. but not exceeding 2-in.
3. All lump coals 1¼-in. and under; all double-screened egg coals with a bottom size of 1¼-in. or under and a top size larger than 2-in.
4. All double-screened nuts with a top size of 2-in. and under.
5. All run-of-mine and modified run-of-mine and all resultants with a top size larger than 2-in. Modified run-of-mine is defined as mine-run from which part of the fines have been removed but which as shipped contains at least 37 per cent slack that will pass through a ¾-in. round-hole screen.
6. All resultant coals larger than ¾-in. but not exceeding 2 in.
7. Slack; i.e., all resultant coals ¾-in. and under
8. Domestic lump coals larger than 5 in.
9. Domestic lump coals in 5x3-in. range.
10. Domestic lump coals in 3x2-in. range.
11. Domestic lump coals in 2x1¼-in. range.

other hand, has picked up materially.

Because 1937 distribution figures have been set up on the basis of the Market Areas proposed under the Bituminous Coal Code, detailed comparisons State by State with data for 1917, 1918 and 1929 published by the United States Bureau of Mines are not possible. The major groupings used in Table I, however, do show little pronounced shifts in long-term trends except in the case of northern West Virginia participation in the tidewater trade. Other than this, such changes as have taken place have been generally favorable to the Fairmont field.

The preponderant part played by industry as a market for northern West Virginia coals is revealed in the analysis of commercial tonnage set out in Table II. In the case of all-rail shipments, 63.711 per cent of the total is mine-run, resultants and slack. To tidewater, the percentage of these industrial sizes rises to 91.028. If 2-in. and smaller double-screened nut coals also are included, the percentages rise to 76.434 and 94.468, respectively. But the picture changes—not unnaturally—when lake shipments are analyzed. Here 61.889 per cent of the total falls into the domestic lump category.

In so far as the all-rail and tidewater markets are concerned, these percentages (76.434 per cent for all-rail and 94.468 per cent for tidewater) understate the importance of the industrial market, since a substantial part of the coals falling in Size Groups 1, 2 and 3 also are used by steam plants. Conversely, of course, some of the coals in these size groups in the lake trade eventually may find their way into retail domestic channels. For the three divisions—all-rail, tidewater and lake—as a whole, shipments of mine-run, resultants and nut coals (Size Groups 4, 5, 6 and 7) accounted for 69.815 per cent of the total movement of commercial coal shipments in these divisions.

How the volume of each of these seven size groups varies with each of the individual Market Areas to which all-rail coal has moved from the northern West Virginia field and to tidewater is shown in detail in Table IV. The same data by major consuming areas are given for all-rail shipments in Table III. Railroad fuel, river and truck tonnage and coal consumed at the mines are not included in the figures given for size distribution. River and truck tonnage and coal consumed at the mines, however, are included in the totals for the northern West Virginia field which enter into the compilations for Table I.

Table III—Territorial Size Distribution

(All-Rail Shipments Only)

	Size Grouping						
	1 Tons	2 Tons	3 Tons	4 Tons	5 Tons	6 Tons	7 Tons
Eastern New England [1]	6,944	9,217	3,313	7,712	58,372	38,457	1,225
Western New England and Atlantic States [2]	253,577	528,086	505,520	948,454	1,130,179	1,374,308	1,772,567
Ohio [3]	400,635	106,564	21,823	153,379	413,147	407,960	179,830
Illinois-Indiana	36,270	28,270	1,897	1,102	139,542	2,907	4,844
Michigan [5]	23,305	50,217	1,646	5,974	12,292	55,459	53,486
Wisconsin [6]	3,400	1,840	473	195	.....	342	390
Minnesota [7]	426	45	.....	.....	.....	.....	563
Iowa [8]	8,704	723	.....	33	.....	.....	.....
Totals	733,261	724,962	614,132	1,116,849	1,753,532	1,879,433	2,012,905

[1] Bituminous Coal Division (Department of the Interior) Market Area No. 1.
[2] B.C.D. Market Areas 2 to 11 inclusive (excluding Canada) and Market Areas 100 and 101.
[3] B.C.D. Market Areas 12 to 19 inclusive; coal to Youngstown included in Market Area 11.
[4] B.C.D. Market Areas 22 to 41 inclusive.
[5] B.C.D. Market Areas 20, 21 and 44.
[6] B.C.D. Market Areas 42 and 43.
[7] B.C.D. Market Areas 45 and 46.
[8] B.C.D. Market Areas 47 to 50, 52, 53, 55, 62 and 65.

Table IV—Size Distribution by Market Areas: 1937

Market Area Number and Description	Size Group* 1 Tons	2 Tons	3 Tons	4 Tons	5 Tons	6 Tons	7 Tons
All-Rail Shipments							
1 Eastern New England	6,944	9,217	3,313	7,712	58,372	38,457	1,225
2 Western New England-New Jersey-New York-Pennsylvania-Delaware-Virginia-West Virginia-Maryland	122,832	332,330	278,590	733,104	879,608	1,146,582	1,523,197
3 District of Columbia-Maryland-Virginia	6,808	6,317	8,283	7,948	4,283	204	53
4 New York-Pennsylvania	32,141	81,658	17,085	142,758	34,136	103,341	66,195
5 Pennsylvania (Warren)	3,616	4,508	695	704	100	.....	3,873
6 Pennsylvania-Maryland-West Virginia	2,415	2,246	8,824	10,046	11,110	3,330	5,216
7 Pennsylvania (Western)	2,758	7,059	31,152	32,892	10,415	3,644	34,094
8 West Virginia (Northern)	35,966	4,796	238,145	11,632	181,278	75,345	116,539
9 West Virginia (Panhandle)	4,628	197	883	.....	.....	.....	.....
10 Pennsylvania-Ohio (Erie)	18,177	2,892	830	3,900	779	33,630	18,064
11 Pennsylvania-Ohio (Youngstown)	23,661	85,067	514	2,840	4,841	3,652	3,279
12 Ohio (Painesville)	53,728	12,730	258	21,592	4,600	307,510	135,786
13 Ohio (Eastern)	249,615	80,769	13,680	104,942	398,598	71,295	38,932
14 Ohio (Philo)	4,753	608	.....	333	.....	723	.....
15 Ohio (Northwest)	21,728	3,705	4,624	8,973	8,677	7,480	427
16 Ohio (Mansfield)	14,775	2,791	950	2,669	107	4,625	479
17 Ohio (Columbus)	30,804	1,271	112	7,631	868	5,202	766
18 Ohio (Sidney)	759	189	239	46	.....	437	112
19 Ohio (Dayton)	24,473	4,501	1,960	7,193	297	10,688	3,328
20 Michigan (Bay City)	6,826	1,681	317	1,244	2,890	996	.....
21 Michigan (Detroit)	16,219	48,536	1,188	4,550	9,402	54,463	53,486
22 Indiana (Fort Wayne)	2,367	298	142	.....	.....	501	48
23 Indiana (Muncie)	7,754	931	1,577	330	138	1,073	.....
24 Indiana (Rushville)	2,021	.....	.....	35	.....	.....	.....
25 Indiana (Brookville)	444	102	.....	.....	.....	.....	.....
26 Indiana (North Vernon)	216	85	.....	.....	.....	.....	.....
28 Indiana (Indianapolis)	2,679	279	.....	95	.....	.....	.....
29 Indiana-Illinois (Chicago)	4,305	23,647	.....	514	14,294	302	.....
30 Indiana (Central)	6,501	674	178	83	56	.....	4,796
32 Indiana (Southwestern)	131	149	.....	.....	.....	.....	.....
33 Indiana (Terre Haute)	50	.....	.....	45	308	1,031	.....
38 Illinois (Central)	4,594	.....	.....	.....	.....	.....	.....
40 Illinois-Missouri (St. Louis)	1,790	.....	.....	.....	.....	.....	.....
41 Illinois-Iowa (Northern Illinois)	3,418	2,063	.....	.....	124,746	.....	.....
42 Wisconsin (Southern)	1,350	417	426	.....	.....	342	102
43 Michigan-Wisconsin (Northern Michigan)	2,050	1,423	47	195	.....	.....	288
44 Michigan (Upper Peninsula)	260	.....	141	.....	.....	.....	.....
45 Minnesota (Northwestern)	44	.....	.....	.....	.....	.....	.....
46 Minnesota (Minneapolis-St. Paul)	382	45	.....	.....	.....	.....	563
47 Iowa (Fort Dodge)	529	.....	.....	.....	.....	.....	.....
48 Iowa (Clarion)	89	.....	.....	.....	.....	.....	.....
49 Iowa (Montezuma)	1,238	130	.....	.....	.....	.....	.....
50 Iowa (Cedar Rapids)	5,400	593	.....	33	.....	.....	.....
52 Iowa (Muscatine)	40	.....	.....	.....	.....	.....	.....
53 Iowa (Burlington)	105	.....	.....	.....	.....	.....	.....
55 Iowa (Audubon)	873	.....	.....	.....	.....	.....	.....
62 Iowa (Radcliff)	47	.....	.....	.....	.....	.....	.....
65 Iowa (Knoxville)	383	.....	.....	.....	.....	.....	.....
100 Virginia - Maryland - West Virginia - North Carolina	528	1,016	519	2,630	3,530	4,580	2,057
101 Eastern Kentucky - Southern West Virginia-Eastern Tennessee	47	.....	.....	.....	99	.....	.....
Tidewater Shipments							
Upper New York Harbor	2,577	7,683	1,345	6,159	17,910	11,414	32,381
Lower New York Harbor	2,179	6,877	10,156	16,628	45,715	45,147	201,055
Philadelphia	5,338	4,870	.....	9,241	274,604	9,271	29,211
Wilmington	.....	.....	.....	.....	267	.....	.....
Baltimore and Curtis Bay	3,005	8,499	.....	630	23,168	4,524	169,525

* For details on size groupings, see footnotes to Table II.

"Super" CESCO DIAMOND
SELF-HARDENING MINE BITS - - -
(Pat. No. RE-17846)

SAVE 15 to 66% POWER COSTS

The tables below were compiled from actual test cuts in a Pittsburgh seam of coal, conducted by one of the largest coal mining companies in the country, with a full time engineer in charge. These figures speak for themselves.

Comparative Performance of "SUPER CESCO DIAMOND" Self-Hardening Mine Bits

TABLE I
Comparison with borod-tipped and ground carbon steel bits using a 9 ft. cutter bar.

Sq. Ft. of Coal Cut	Cutting Time Savings	Power Savings
(% Increase)	(% Decrease)	(% Decrease)
40%	40%	15%

TABLE II
Comparison with borod-tipped and ground carbon steel bits using a 6 ft. cutter bar.

Sq. Ft. of Coal Cut	Cutting Time Savings	Power Savings
(% Increase)	(% Decrease)	(% Decrease)
40%	Approximately same cutting time.	25%

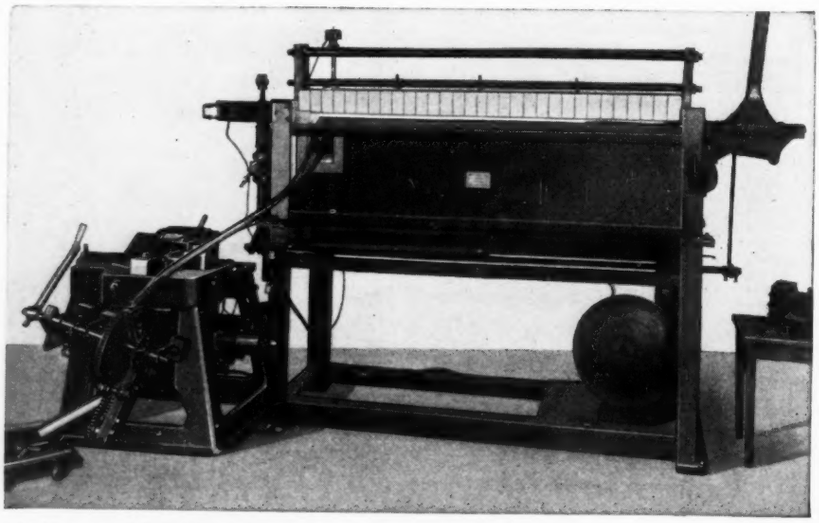
TABLE III
Comparison with heat-treated carbon steel bits (.85 C) using a 6 ft. cutter bar.

Sq. Ft. of Coal Cut	Cutting Time Savings	Power Savings
(% Increase)	(% Decrease)	(% Decrease)
400%	40%	66%

Greatly Reduce Bug Dust

The free cutting action of these bits not only cuts power costs, as shown in the tables, but also reduces bug dust, producing larger screenings and largely eliminating explosion hazards. Sharpness of bits puts less strain on armature shafts, ropes, chains and feed mechanisms of cutting machines.

Because "SUPER CESCO DIAMOND" Self-Hardening Mine Bits stay sharp longer, only about ¼ as many bits are required per day . . . expense of redressing is greatly reduced . . . and less time is lost in changing bits on cutting machines.



The New "SUPER" Mine Bit Forging Machine and Furnace

The "SUPER" Mine Bit forging Machine and "SUPER CESCO DIAMOND" Self-Hardening Mine Bits will effect savings you can't afford to overlook. Write for full particulars today.

The New "SUPER" Mine Bit Forging Machine

The "SUPER" Mine Bit Forging Machine (Pat. Nos. 1,818,601; 1,857,011 and 1,937,625) is capable of forging 420 new bits per hour or redressing 600 worn bits per hour. Machine and furnace are both semi-automatic, and the furnace is equipped with positive automatic electric temperature control to assure uniform forging of mine bits. Forges high alloy steels, such as "SUPER CESCO DIAMOND" Self-Hardening Steel, that are too tough to forge by hand or by other machines.

L. M. BROWN, INC.
100 E. Seventh Ave. HOMESTEAD, PA.

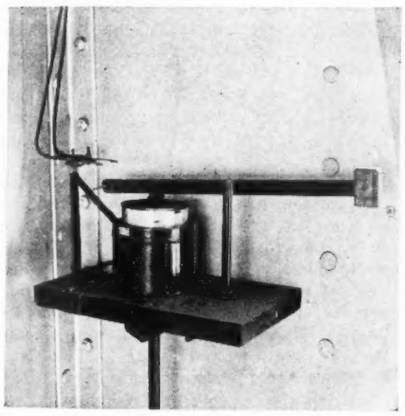
OPERATING IDEAS

From

Production, Electrical and Mechanical Men

Switch Cuts Off Mine Power When Fan Pressure Drops

Pressure switches are installed on the Robinson Run No. 2 fan of the Christopher Mining Co., Maidsville, W. Va., to cut off all d.c. power to the mine in case ventilating pressure drops more than 0.2 in. of water gage for any reason. One pressure switch is at the fan near the main portal, where one substation is located, and the other switch is underground 6,000 ft. away near the bottom of a 146-ft. borehole at another surface substation containing a 400-kw. rectifier.



The weight is poised to raise the contact bar at the opposite end and cut off the mine power in case ventilating pressure drops.

The fan is a Jeffrey 8-ft. Aerodyne operating exhausting and handling 131,000 c.f.m. at a water gage of 1.6 in. The construction of a pressure switch is indicated in the accompanying illustration depicting the installation in the fan house. The base is a coffee can 4 in. high and 5 in. in diameter, and the air pipe, which is soldered where it goes through the bottom of the can, extends up 4 in. A second can, 4⅛ in. in diameter and 4½ in. high, is hung from a balance arm and is open at the bottom. Oil poured in the can forms a seal and thus the suction of the fan holds the upper can down. The weight is adjusted so that a pressure drop of 0.2 in.—i.e., down to 1.4 in.—will result in the upper can pulling out and shorting the electrical contacts.

The switch back in the mine works on the pressure difference between the intake and return airways at that point. Shorting of the contacts actuate relays which open the automatic breakers but prevent them from reclosing upon restoration of normal pressure until manual operation indicates that the workings are safe for a power return. A button must be pushed at the main portal substation, thus energizing a line and actuating a relay to allow reclosing of the breaker in the distant substation.

—⟡—

Insulation Resistance Checked To Forestall Delays

The threat of delays through the failure of important electrically operated machines is forestalled at the Federal Nos. 1 and 3 mines of the Koppers Coal Co., in northern West Virginia, by heeding warnings given by low values of insulation resistance. The values are obtained with a "Megger" and are recorded in the office of the division electrician at Federal No. 1, Grant Town.

A record card is shown in the accompanying illustration and depicts graphically the story of the rotor fields of a synchronous motor in No. 4 substation, No. 1 mine. The first reading was made Dec. 1, 1934, and the last Feb. 26, 1939. When readings were low, cleaning and painting restored the resistance. A separate card is used for recording the tests of the stator winding of this motor, and similarly two cards are used for the d.c. generator of this set. By this system, data are accumulated for the separate parts of all the principal items of substation, distribution and large power units.

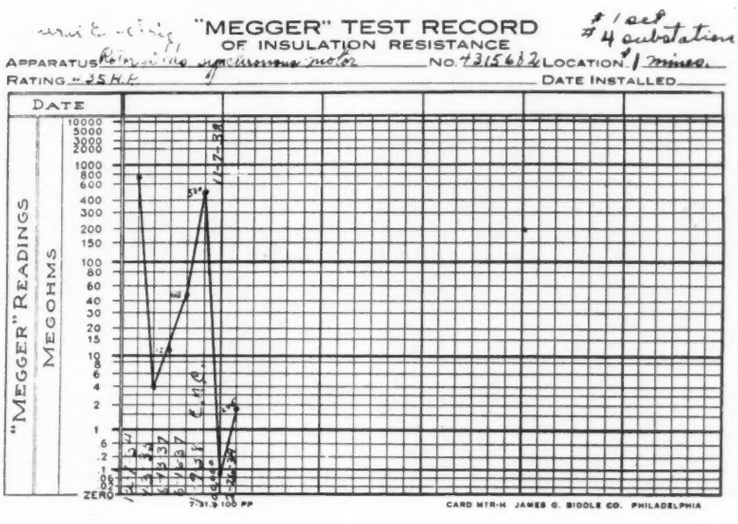
—⟡—

Cable Splices Are Vulcanized At Federal No. 1 Mine

Four temporary splices are the maximum allowed in a trailing cable before it must be removed and vulcanized at Federal No. 1 mine of the Koppers Coal Co., Grant Town, W. Va. An unusual feature, which simplifies handling and vulcanizing, is the fact that cables are identical on the three types of d.c. machines: cutters, loaders and 8-ton gathering locomotives. These cables are of the two-conductor concentric type (No. 2 wires, rubber sheath) in 450-ft. lengths. This two-conductor, instead of single cable, is used on locomotives because the mine is gaseous and only permissible and flameproof equipment is used in working places.

A cable-repair and vulcanizing room was added to a substation building at the

A low reading foretells electrical trouble.



In setting up a cable-repair and vulcanizing shop handy equipment and good light were recognized as the first necessities.

top of a borehole two miles from the plant in 1939. One man does the repairing and also tends the substation (two 200-kw. 275-volt m.g. sets with manual starting boards and reclosing feeder breakers). Instead of purchasing automatic boards for the two sets and doing without the operator, the present arrangement was selected as the better alternative. Heavy loads incident to mechanical loading have demonstrated in a number of substations at various mines that an operator is an advantage even though the starting equipment may be automatic.

An accompanying illustration shows the combination steel work bench and tool cabinet which facilitates the cable work. Clamps hold the cable in working position and a clamp at the right is mounted on a screw-type adjusting base, thus providing a means of tightening the cable. The well in the center of the bench provides clearance for working the strands in making the splices and for ease and speed in taping. In the illustration, the operator is beginning to apply rubber tape over the inner conductor, which has been spliced with a Newberry clamp.

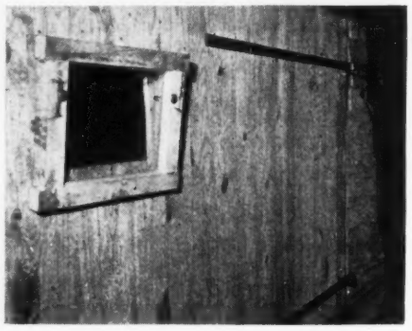
The vulcanizer is on a bench back of the splicing well and is a No. 2 size 2,000-watt 220-volt Mines Equipment Co. unit. In the second illustration, the operator is switching on the vulcanizer after the cable joint has been completed and clamped in the mold. All good pieces of cable up to 10 ft. in length are utilized in building up new cables of the required 450-ft. lengths. Before the unit went in, early in 1939, cables were not vulcanized. Utilizing the short pieces has cut cable cost, delays have been reduced and safer operation has been assured.

Turning on the power to cook the rubber covering of the joint.

—⁂—

Slanting Peepholes in Doors Eliminate Reflections

Mine doors at the Dawson No. 2 operation of the Dawson Coal Co., Clarksburg, W. Va., and other northern West Virginia operations are equipped with windows in which the glass is set out of plumb to eliminate reflections. Glass size at Dawson is 14x14 in., and the pitch is 1½ in. in 14. With the windows on a slant a man approaching the door does not have to shade his cap lamp to see through. No main doors are used at Dawson, which instead relies on overcasts.



Slanting glass in a section door, Dawson No. 2 mine.

Encore!

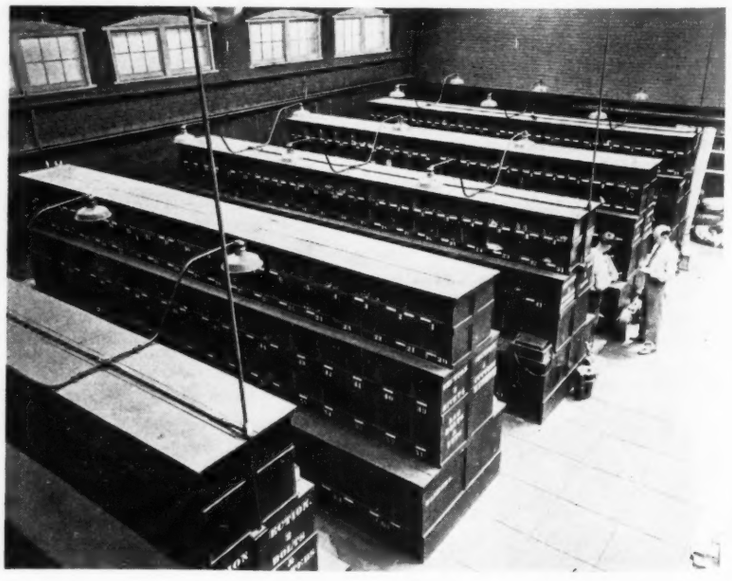
Again Coal Age canvasses a major producing district for the latest ideas in all phases of production, preparation, electrification, maintenance, safety, etc.! In this issue the editors feature the mechanized mines of the Fairmont field of northern West Virginia and in this department offer a few of the many cost-cutting safety-promoting short cuts developed by operating, electrical, mechanical and safety men in the region. But we'll be back next issue with items from all over the country, which is where you can do your part. If you've schemed up something which has helped you in your every-day work, here is the place where you will get both credit and cash. So send in your kink, along with a sketch or photo if it will help to make it clearer. For each acceptable idea, Coal Age pays $5 or more on publication.

Special Lighting Provided In Jamison Supply Room

Illumination—natural and by electric lighting—was given special attention in building and equipping a supply room at No. 8 mine of the Jamison Coal & Coke Co., Farmington, W. Va. As a starter, bins were spaced and shaped to simplify the lighting. Then both general and local lighting were designed with true regard to supply-house problems.

Bins, as indicated in the accompanying illustration, are stepped back to narrower sections at the top, thus allowing light to strike them from various angles. The open space is 6 ft. between top sections and 39 in. between bottom sections. Bins are set crosswise in the room so that the natural light from side windows is utilized to the best advantage. These side windows are high above the floor, which

Natural lighting is excellent and artificial illumination is of the same caliber.

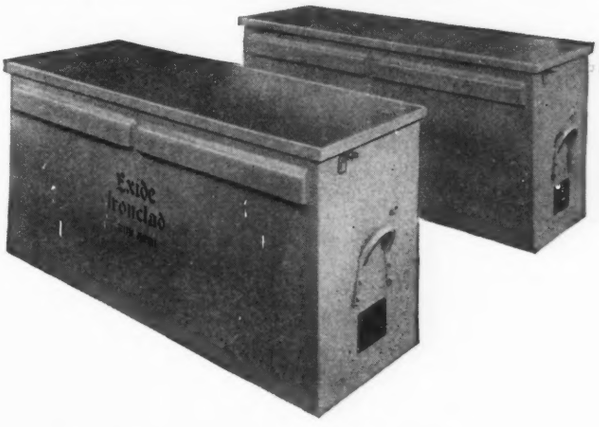


To get the Most from a shuttle car

. . . POWER IT WITH EXIDE-IRONCLAD

THE good record of rubber-tired shuttle cars has rapidly earned them a place in more and more mines. The greater flexibility they bring to a mechanized operation helps to increase production economically. This is especially true when they are powered with Exide-Ironclad Batteries.

When you order a shuttle car, you can insure excellent performance by equipping it with an Exide-Ironclad. You will get enormous reserve power for heavy loads and steep grades, good speed for productive operation all day long, and the sure dependability for which all Exide-Ironclads are famous.



In shuttle cars and locomotives alike, you will find Exide-Ironclads able to speed up your haulage, day in and day out, with economy. Write for free booklet, "The Storage Battery Locomotive for Underground Haulage."

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
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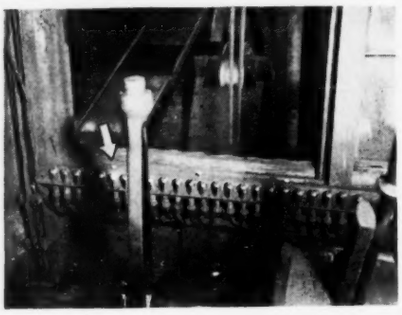
helps in illumination between the bins.

Local lighting, with control switches for each row of three lamps on the bins, consists of 100-watt lamps in RLM reflectors. They are mounted midway between the bins with the bottoms of the reflectors 6 in. above the top line of the bins. General lighting is supplied by 500-watt lamps in RLM reflectors. These are above the field of view in the illustration.

Remotely Controlled Indicator Shows Trip Position

Slope hoisting at the Continental No. 4 mine of the Continental Coal Co., Cassville, W. Va., includes two unusual features: a reverse-stepped drum and a remotely controlled trip-position indicator. The slope is 600 ft. long, the grade is 33 per cent, and the total hoisting distance is 800 ft. A hoisting cycle takes 1 minute 13 seconds. Three- or four-car trips are handled in balance, and the cars are emptied by two rotary dumps in the top of the tipple, each dump capable of handling an entire trip at one time. Car



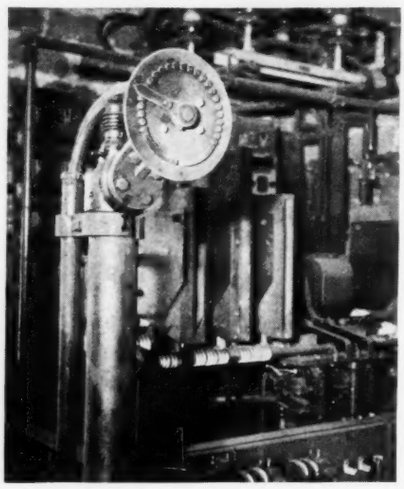
Only the lamp indicated by the arrow is lighted. A white target just above it shows that it is time to slow down the hoist.

weight is 3,850 lb.; average loading is 3 tons.

The hoist house is on the ground directly over the slope portal and the operator's station is up in the tipple between the tracks facing the lower ends of the dumps. This places his back to the hoist. An Ottumwa hoist is used and is driven by a 400-hp. 2,300-volt 600-r.p.m. wound-rotor motor (General Electric). Drums are stepped down at the ends so that the empties still are descending at high speed while the loads are slowed down for the dump without touching the controller.

Trip position is shown the operator by a row of 24 lamps, which light in succession as the trips move along the slope through contacts on an insulated disk that replaced the conventional indicator dial on the hoist. The pointer was replaced by a hand with a wiping contact spring. The indicator is geared so that the hand makes about seven-eighths of a revolution for a complete hoist. Twenty-four power wires extend from the buttons to the respective signal lamps.

Six-volt 3-c.p. lamps of the standard type used in automobile tail lights are used in the control station. These are powered from a toy transformer and, due



Contact dial which replaced the indicator dial on the hoist.

to the length of the circuit, the voltage is considerably below normal. This is an advantage because the operator prefers a dim light and, moreover, the lamp life is much greater.

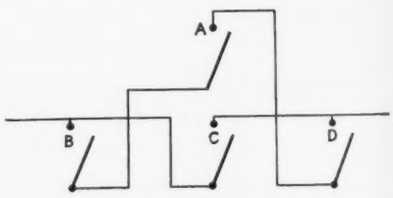
Fireproof Oil House Eases Handling of Barrels

Fireproof construction, equipment to eliminate manual lifting and much rolling of heavy barrels, and provisions for handling spillage and drips are desirable features of any oil house. All three are incorporated in the house at Jamison No. 8 mine, Jamison Coal & Coke Co., Farmington, W. Va.

A monorail track with trolley and chain blocks extends from the truck-parking spot outside the door all around the oil-house walls. The illustration shows a barrel just brought in and still hanging on the hooks of the chain blocks. In front of the elevated platform along the left side, where barrels are drained to smaller containers, a trench in the concrete floor leads to a covered sump where spillage is collected. A pump (in front of the low wall in the center background) drains the sump. The oil thus salvaged is used on tipple conveyors and in other open-bearing duties in dusty places.

Isolating Switches Included In Breaker Mountings

Switches for complete isolation are included in semi-portable mountings for 275-volt automatic stub-end feeder breakers used in Federal No. 1 mine, Koppers Coal Co., Grant Town, W. Va. This arrangement affords the section foreman an opportunity to test the breaker in case it stays out when he thinks that perhaps the line is clear. And if he does find the breaker at fault he can short it out and continue operation until an electrician arrives. Furthermore, the switch arrangement allows the electrician to completely disconnect the breaker from the line for



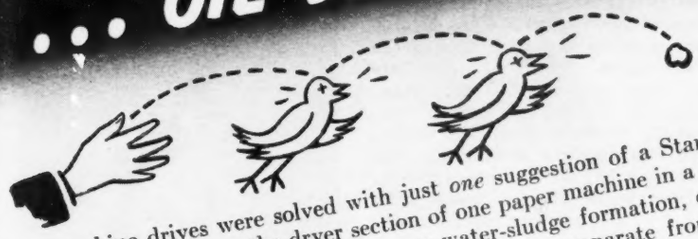
This arrangement facilitates checking and inspection of automatic breakers.

inspection or repair without stopping production.

In the schematic wiring diagram shown in the accompanying illustration, *A* is the main contact of a 1,200-amp. automatic breaker and *B*, *C* and *D* are 2,000-amp. special quick-break knife switches without handles but with holes in the ends of the blades for hook-stick operation, which is considered safer. The automatic

Designed for ease and safety in handling oil.

TEMPERATURES REDUCED 25%
... OIL SLUDGING STOPPED



Two birds with one stone! *Two* troublesome operating problems on paper machine drives were solved with just *one* suggestion of a Standard Lubrication Engineer. ● Gear drives on the dryer section of one paper machine in a Wisconsin mill were running dangerously hot. Besides, there was water-sludge formation, caused by the fact that condensate on the inside of the gear case did not separate from the oil. This condensation occurred when cold water, used in washing up around the machine, struck the outside of the warm gear case. ● The Standard Lubrication Engineer did two things. He made certain that the alignment and load on the unit were satisfactory, and he recommended the right grade of Stanoil. Both the high temperatures and the sludging were eliminated. Now *all* reduction gears in this plant use Stanoil. ● This and other high quality lubricants and the engineering service to apply them most economically are available to all operators in the Middle West. Just write Standard Oil (Indiana) 910 South Michigan Avenue, Chicago, Illinois, for the engineer nearest your plant.

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STANOIL

STANDARD OIL COMPANY (INDIANA)

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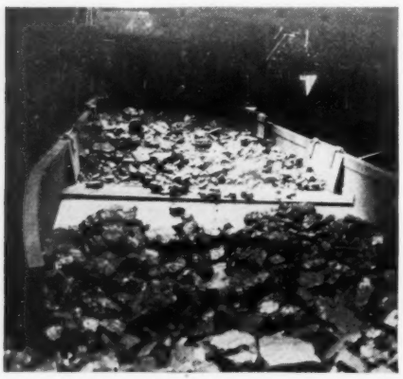
breaker and a steel box inclosing the three knife switches are mounted together, back to back, on an angle-iron rack with long feet so that the assembly will stand upright safely without bracing.

—❖—

Degradation Kept Out of Lump By Side Plates on Screen

To prevent small coal from working down the sides of the screen jackets and going over into the lump, side plates are used on the main screen at Dawson No. 2 mine, Dawson Coal Co., Clarksburg, W. Va. These baffle plates crowd the fines out onto the jacket so that they will go through the perforations. The plates are hinged as shown so that they may be lifted up for changing jackets, etc.



The hinged side plates keep small coal from creeping down the sides and going over into the lump.

—❖—

Tramp-Iron Magnets Set Under Chutes

When electromagnets of the flat rectangular type were purchased for the chutes feeding the washer at Continental No. 4 mine, Continental Coal Co., Cassville, W. Va., the first supposition was that sections of the steel chutes would have to be cut away and non-magnetic material such as bronze or manganese steel inserted. But experiments with a magnet before installation showed that no changes in the chutes would be necessary.

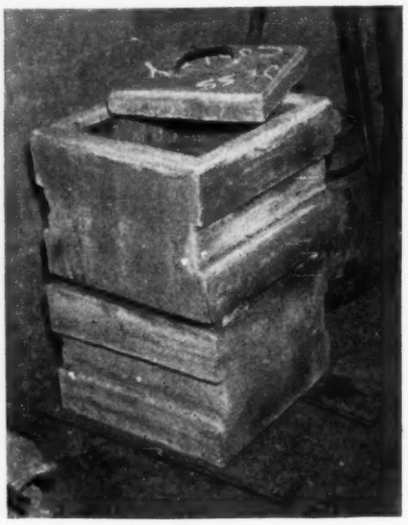
Broken car bolts clinging tightly to the chute bottoms, with some held on end, are shown in the accompanying illustration. This picture was made by turning d.c. on the magnets and then placing the bolts in the chutes. The ½-in. steel chute is able to short only a small percentage of the magnetic lines, thus leaving sufficient field to securely hold the tramp iron. The two magnets serving the two chutes handling 5x⅜-in. coal are 4½x16-in. Central Electric Repair Co. units 5 ft. long.

Demonstrating that magnetism penetrates the steel plates of the chutes.

—❖—

Powder Storage Boxes Made of Concrete

For transporting powder and storing it on the working sections until it can be used, concrete boxes are used at the Rachel mine of Jones Collieries, Inc., Rachel, W. Va. Two of these boxes, which stack easily and are slotted on the outside for easier handling, are shown in the accompanying illustration. Lids also are made of concrete with a handle embedded in them. The boxes, naturally, are fireproof, and the powder is better protected from falls and other shocks.



Made of concrete, these boxes provide more convenient and safer storage of powder in working sections.

—❖—

Non-Pull-Out Connection In Fused Trolley Taps

Fused trolley taps of the clamp-and-glider type used at the mines of the Jamison Coal & Coke Co., Farmington, W. Va., are ordered with an extra terminal clearance in the Bakelite base to accommodate a non-pull-out terminal connection devised at the mines. This eliminates most of the difficulties formerly experienced in maintaining a terminal connection in condition to withstand the strain.

A tap with the case unscrewed and pulled back to indicate how the cable connection is made is shown in the accompanying illustration. From around the screw the end of the stranded conductor is looped back and fastened by means of a Newberry splicing sleeve. This makes a connection as strong as the cable.

The connection is as strong as the cable in this trolley tap.

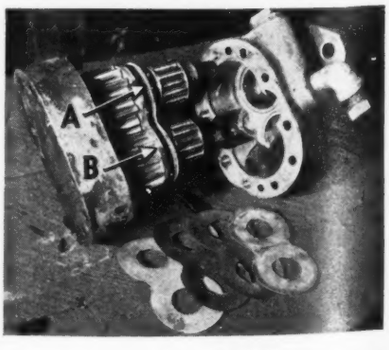
—❖—

Shimming Hydraulic Pumps Cuts Maintenance Cost

Maintenance cost on hydraulic pumps on Joy 11BU loading machines at Rosedale mine, Rosedale Coal Co., Maidsville, W. Va., has been held to a low figure by applying a shim back of the bronze liner and using a gasket of thickness to suit instead of buying new liners. During sixteen months of service with four loaders working three shifts a day, only two new pump liners were purchased and those before shims were adopted.

In the illustration, *A* is an 0.012-in. shim which is being installed in the pump back of the bronze liner, *B*, to compensate for liner and gear wear. This pump had been in use with shims of 0.002, 0.005

Pump ready for assembly with the thickest shim.



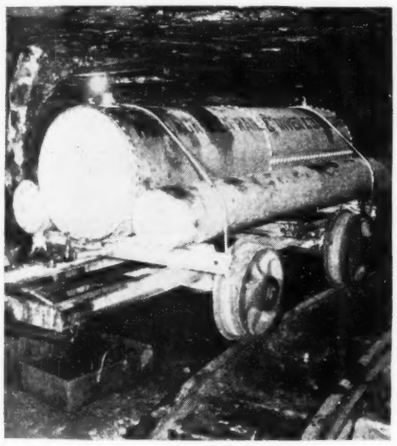
and 0.010 in. as wear increased. Shims of the four sizes lie on the bench in front of the pump.

Pumps are tested by attaching a gage to the discharge, filling the pump with oil and giving the shaft a quick turn with a wrench. On a new pump it is possible to get a gage reading of close to 3,000 lb. However, a repaired pump that will register 500 lb. is considered satisfactory for service.

—❖—

Tank Car Handles Oil At Emily Mine

To get away from the difficulties of loading and unloading oil drums from mine cars, a special tank car has been built at the Emily mine of the Monongahela Rail & River Coal Corporation, Maidsville, W. Va. The center tank (see illustration) holds 200 gal. of hydraulic oil, which is used on three Whaley "Automat" loading machines, one Jeffrey 29-LE cutter and one Sullivan 7-AU cutter.



This truck carries 7 bbl. of mine lubricants.

Each small tank holds 50 gal. of clutch oil. The drip pan on the floor under the faucets is fitted with convenient handles and is carried on the front platform of the truck.

—❖—

Trolley-Fed Nip Installed In Rosedale Shop

Neater and much more convenient than the usual extension cable is the trolley-fed nip used in the outside repair shop at the Rosedale mine of the Rosedale Coal Co., Maidsville, W. Va. It is used for moving such self-propelled d.c. equipment as cutters, loaders and locomotives in the shop, and for d.c. power for testing.

A 2/0 bare copper wire the length of the shop is hung by strain insulators at each end so that an inverted trolley wheel can move freely from end to end. One end of a 13-ft. No. 1 flexible rubber-covered cable is attached to the yoke, or harp, of the wheel bearing. A 3-ft. solid hook nip is attached to the other end of the cable, thus affording a total reach of 16 ft., sufficient for machinery on both shop tracks.

The illustration shows the nip attached

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Logan County Coal Corp.
Lundale,
West Virginia
Thanks for letting us tell other operators about the 30% cut in power costs which your electrician says you have experienced!

Typical of the reports that come in to us from users of Cincinnati Duplex Chains and Reversible Bits is word received recently from the Logan County Coal Corporation whose electrician estimates power savings up to a third and machine maintenance reduced proportionally since installing Cincinnati equipment. Knowing that the experience of others counts much in selecting mine machinery, we asked this prominent operator to let us "tip off" the industry to this proven way of boosting profits. The CINCINNATI DUPLEX combination . . . better bit, sturdy holder, and chain practically unbreakable . . . is positive assurance of increased production, decreased costs, and less waste because the cuttings are coarser. Put to work on *your* property, Cincinnati Chains and Bits can be counted on to bring new profits to your production as they have to Logan County. Won't you let us give you complete details?

The Cincinnati Mine Machinery Co.

Spring Grove & Meeker St. **Cincinnati, Ohio**

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ELECTRIC COAL DRILL

Profit-promoting efficiency begins at the face—and at the face of the Bunker Mine, "THE CINCINNATI" Electric Coal Drills speed up production at a truly profitable pace. "More power per pound" and long, trouble-free service. If you are not using "THE CINCINNATI" Drills, why not investigate this means of setting a faster, more economical pace for your operations too. Sold on a money back guarantee.

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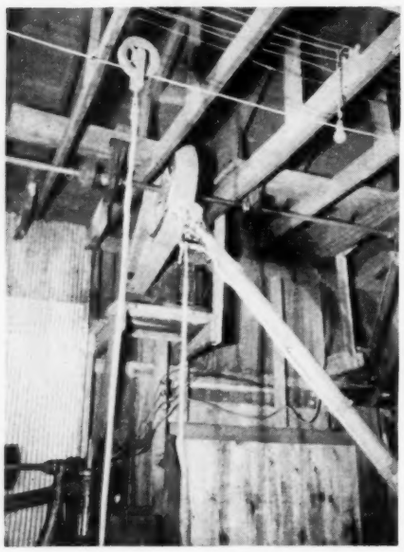


Takes d.c. anywhere in the shop without the inconvenience of the usual long cable.

to the business end of a locomotive trolley pole, with the loop extending down below the field of view. When not in use, the nip is hung on the trolley wire. All but the last few inches of the stiff end of the nip is insulated heavily with tape. The trolley wire is 10 ft. above the floor at one side of both tracks, where it is out of the way of workmen using bars or other long tools. The bottom of the loop made by hanging up the nip clears the floor by 2 ft.

—⟡—

Board Shows Men Working On Each Loading Unit

By a glance at the check board, officials at the Robinson Run No. 2 mine of the Christopher Mining Co., Maidsville, W. Va., can determine the number of men assigned each shift to a loading-machine unit and also see if a regular man is missing from any crew. This is made possible by dividing the check board in the lamp house into 21 spaces corresponding to that number of machine shifts a day.

The upper row of seven spaces, as shown in the illustration, is for one shift, the next row for another, and so on. Eleven to thirteen men is the normal figure for a crew and the total men working underground on the three shifts is around 325. Total tonnage shipped per day, all mechanically loaded, is 5,500.

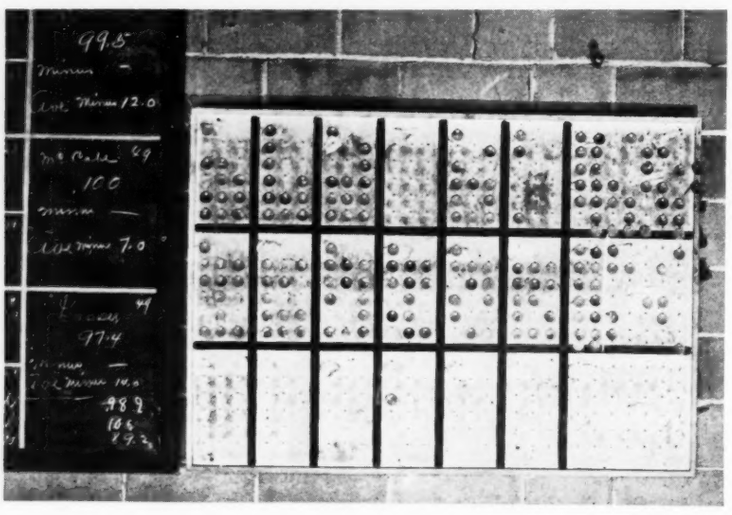
—⟡—

Lip Added to Chute Magnet Makes Operation Surer

A Central Electric Repair Co. chute-type magnet is used in the mine-run chute ahead of the main shaker screens at Dawson No. 2 mine, Dawson Coal Co., Clarksburg, W. Va., and, to make the operation of this magnet more sure in removing tramp iron, a lip is welded on the face as shown in the accompanying illustration. In operation, the tramp iron tends to work down to the lower side of the lip, which then protects it from being struck by chunks of coal coming down the chute.

The lip makes tramp-iron retention more certain.

Check position on the board indicates shift and crew.



Old Tipple Chutes Used For Mine Tool Boxes

Old chutes reclaimed in the reconstruction of the tipple were made into tool boxes for machine crews and the like underground at the Emily mine of the Monongahela Rail & River Coal Corporation, Maidsville, W. Va. Plates were welded in one end of each chute, with collars on the opposite ends to which hinged doors are fastened. The doors are arranged for padlocks so that tools may be left in the boxes in safety.

With hinged tops and padlocks, these tool boxes were made from old tipple chutes.

—⟡—

Loading-Machine Improvements Facilitate Operation

Several mine-made improvements to suit local conditions are shown in the accompanying close-up of a Joy 7BU loading machine in the Continental No. 4 mine of the Continental Coal Co., Cassville, W. Va., where seam thickness is 5½ ft and rather close timbering is the rule.

Originally, the high and low lever was bent as a result of hitting timbers so that it would allow only one side of the clutch to work. Sometimes a jaw corner would be torn off due to the short engagement of the jaws. The original straight lever was bent up 90 deg. (*A* in the illustration) so that it no longer extends beyond the frame of the loader. This required building a curved guide, *B*, instead of the straight one. In the clutch itself, the jaws were changed to 15 deg., thus eliminating any tendency to pull out.

A piece of conveyor belting was placed at *C* from the top of the controller to the boom to prevent coal rolling down and wedging the clutch control. On the reverse lever a thumbscrew was added to lock it into position so that some time is required to loosen it to reverse, thus preventing plugging. A pressure grease

WYCKOFF

Since 1855

Cut mine drainage costs WITH THE PIPE *that* DEFIES CORROSION

Wyckoff Wood Pipe, made of all clear heart stock California Redwood, is used at leading mechanized mines in Northern West Virginia, and all through the mining regions because its use insures low cost handling of mine waters high in acid content . . . thus sustaining its reputation, dating from 1855, for standing up under the severest tests of mine service for a long term of years, particularly for drainage lines.

● Length of new Wyckoff wood pipe, 6-in. dia. in mine drainage service in Continental Mine of Continental Coal Co., 750 ft. of this pipe is now being installed for a new section of the mine to be dewatered and is to be a permanent installation.

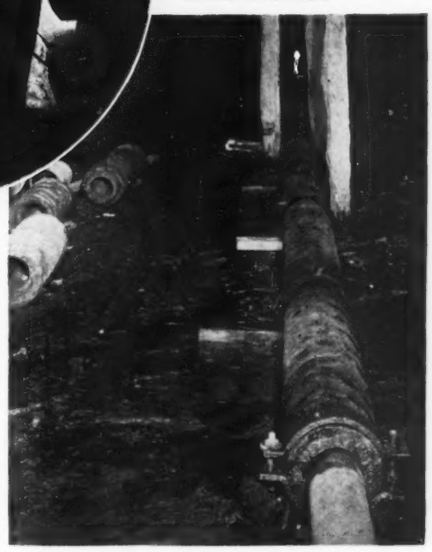
Why super-enduring REDWOOD defies corrosion

Clear California Redwood pipe has greater carrying capacity than metal or concrete pipe. Does not clog, scale or pit. Light weight. Easily installed. Not affected by electrolysis, worms, frost and resists heat. Sizes 1" and up, Pressures up to 172 lbs.

Use Wyckoff Wood Pipe all around the mine—wherever there is any problem of resisting liquid corrosion, fumes or grit. Special hard maple stave pipe can be furnished for flushing culm etc. We can also furnish white pine stave pipe as well as bored pine pipe from the solid log. We also manufacture a superior underground All Clear Redwood steam pipe casing. General Catalog sent on request.

● A few of the many installations of Wyckoff Wood Pipe in the Northern West Va. coal fields working under the most trying conditions.

● Wyckoff 8-inch wood pipe in mine drainage service handling highly acidulous mine water in Mona mine. Pipe line is 1600 ft. long.



● Wyckoff 6", 550 ft. long, discharge wood pipe in mine drainage service handling high acidulous water in Emily mine of Monogahela Rail and River Coal Corporation.

At Eagle Mine of Getty Coal Company there is a 500 ft. Wyckoff Wood Stave Pipe Line. The Laura Lee Mine of the Hutchinson Coal Company uses 6" and 7" diameter Wyckoff Wood Pipe for drainage.

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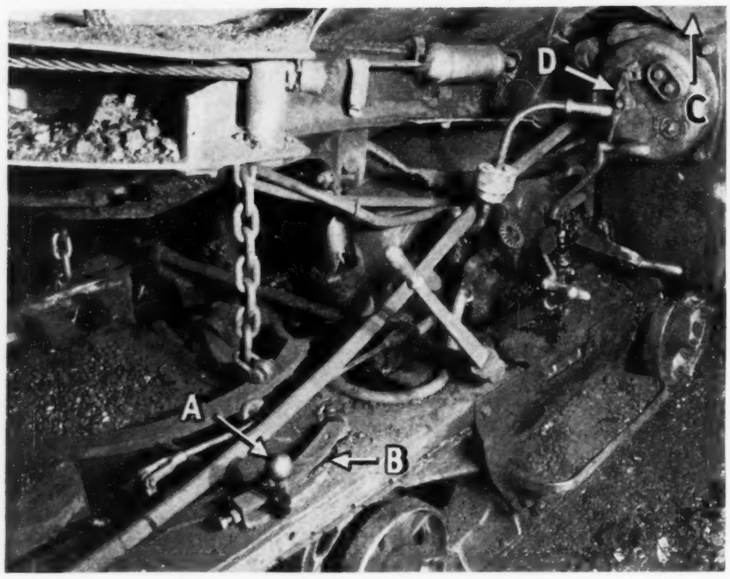
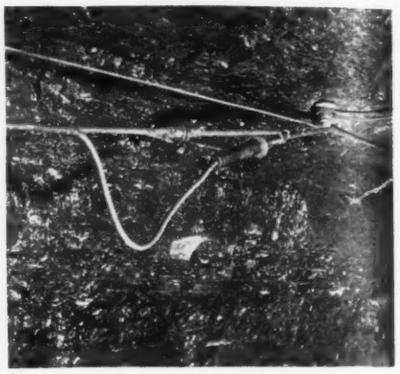
The Originators of Machine Made Wood Pipe



Illustrating several improvements on the control side.



Cable connection to nip is relieved of strain.

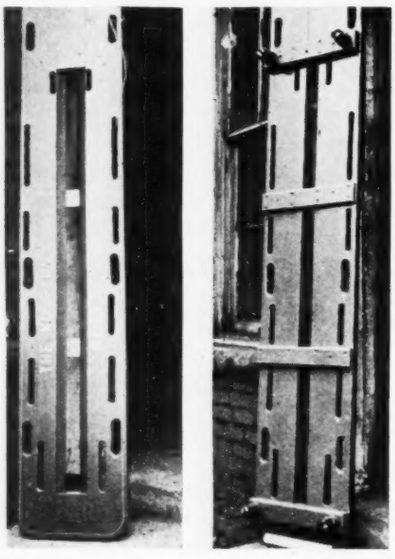
gun can be seen in a secure and protected position under the wing at the top. When the gun was carried on the bumper it was not unusual for it to be jarred out and, if not noticed, be run over and destroyed.

—❖—

Stretcher Board Facilitates First Aid to Injured

A stretcher board designed by mine officials is used at the Federal No. 1 mine of the Koppers Coal Co., Grant Town, W. Va., in handling any serious injuries which might occur. This board, which is equipped with porcelain insulators for legs, provides not only a convenient means for transporting an injured man but also is designed to facilitate the proper application of splints, bandages, etc. Once properly treated and strapped to the board, an injured man may be stood up in most cases without displacement of injured parts or first-aid applications. Four carrying slots are provided, with other slots for use in applying splints or strapping the man to the board.

Top and bottom views of the improved stretcher board developed at Federal No. 1 mine.



—❖—

Strain Take-Ups Installed On Fused Trolley Taps

Pulling the trailing cable loose from the terminal connection in the fused trolley tap—a difficulty experienced at many operations—has been eliminated at the Dawson No. 2 mine of the Dawson Coal Co., Clarksburg, W. Va., as shown in the accompanying illustration. The cable in this particular case is a No. 3 550-volt unit on a 6-ton car-changing locomotive.

The pull between the strain insulator and the nip proper is taken by a steel rod with a hook engaging an eye brazed to the nip. Thus, the entire tap, or just the nip itself, can be renewed quickly. The steel rod from the strain insulator to the nip is taped heavily. When they started using taps with strain insulators the motormen thought them a bit clumsy but soon found that this was outweighed by more satisfactory service.

—❖—

Steel Frames Installed At Mine Portals

Coal corners at the top and sides of drift portals at the Dawson No. 2 mine of the Dawson Coal Co., Clarksburg, W. Va., are protected by steel frames and the usual bulk of concrete is missing. The mine recovers the Pittsburgh seam and soil was stripped off the overlying shale for a distance of 30 ft. back up the hillside. A low concrete wall was built to divert water and stop any soil that might wash down.

The striking appearance of these portals—in a coal face cut to engineering marks—is indicated in the accompanying illustration made as a crew was coming off shift. A frame consists of 45-lb. rail notched, bent and arc-welded to shape. It is held in place by four 1-in. bolts 2½ ft. long cemented into slots cut in the rib.

A steel-framed portal at Dawson No. 2 mine.

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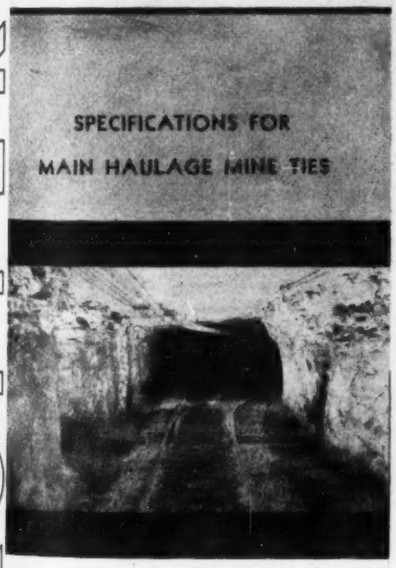

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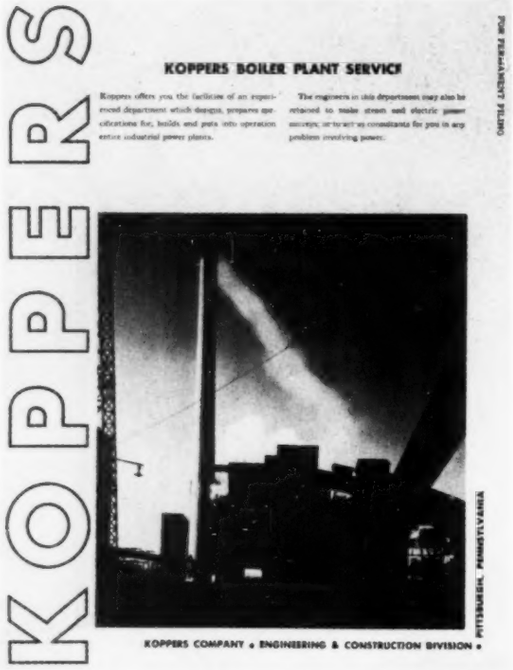

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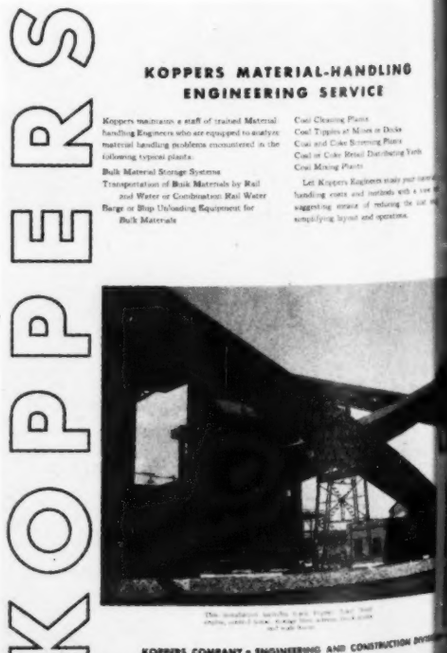

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HERE ARE FOUR TYPICAL SHEETS

WORD FROM THE FIELD

Coal-Price Hearings Proceed; Court Rebuffs Opponents

Washington, D. C., Nov. 18—Final price hearings by the Bituminous Coal Division were resumed on Nov. 13 after a ten-day recess, due to illness of Dr. Charles J. Potter, government witness. According to Director Gray of the Division, there will be no delay in establishment of minimum prices because of the recess, as he plans night sessions to make up for lost time. Secretary of the Interior Ickes optimistically predicted on Nov. 16 that minimum prices would be posted by Jan. 1, unless prevented by what he termed "obstructive tactics" of opponents of the Guffey control act. Meanwhile, hearing sessions are nearing the beginning of their fifth month, having started on July 27.

The Division has called a hearing starting Nov. 27 for establishment of maximum discounts or allowances from minimum prices which producers who will be subject to them may grant to registered distributors after the prices become effiective. At the same time the trial examiner conducting the hearing will hear further evidence on the definition of persons who can be registered as "distributors."

Supplemental proposals on prices and classifications for additional rail and truck mines in Districts 1-11, 13, 16, 18, 19 and 22 were made public by the Division on Nov. 3, and are to be considered part of the subject matter of the final hearing in progress.

Resort to the courts continues to be without profit to opponents of the coal act, as exemplified by setbacks to the Sunshine Anthracite Coal Co. and the city of Atlanta before the U. S. Supreme Court early this month. On Nov. 6 the court entered a straight denial of a writ of certiorari in the Sunshine case, the company having petitioned the court to review the decision of the Eighth Circuit Court of Appeals upholding the Coal Division's order holding the company subject to the coal act. In its order regarding the petition of the city of Atlanta for a ruling on the constitutionality of the Guffey act the court ruled on Nov. 13 that the Georgia city lacked legal standing for the test. Atlanta had attacked the law on the ground that establishment of minimum prices would seriously damage the city, but argument on the case was abruptly ended on Nov. 7 when Chief Justice Hughes indicated that Atlanta had no rights in court because the prices had not been put into effect and therefore the city had not suffered any damage yet.

Seneca Breaker Again Working

Seneca breaker of the Pittston-Duryea Coal Co., Pittston, Pa., is again in action running through bank coal, having resumed on Nov. 6.

U.M.W. Orders $2 Assessment

A special assessment of $1 per month for two months has been levied on its members by the United Mine Workers. The extra levy will be collected from bituminous miners in December and January, and from anthracite workers in January and February. In announcing the assessment, the union circular explained that "it is evident that the groundwork is being laid for repressive anti-labor anti-social legislation, and it is necessary that the organization be in a position to meet every issue and to challenge every adversary."

Keeping Step With Coal Demand

Bituminous Production

Week Ended	1939 (1,000 Tons)	1938* (1,000 Tons)
October 7	10,175	7,995
October 14	10,430	8,302
October 21	10,450	8,140
October 28	10,425	8,650
November 4	10,260	8,115
November 11	9,926	8,185
Total to Nov. 11	324,578	284,865
Month of October	**45,255**	**34,989**

Anthracite Production

October 7	1,245	1,143
October 14	1,224	1,185
October 21	1,194	864
October 28	1,134	880
November 4	743	887
November 11	918	818
Total to Nov. 11	44,548	39,314
Month of October	**4,955**	**4,180**

* Outputs of these two columns are for the weeks corresponding to those in 1939, although these weeks do not necessarily end on the same dates.

Bituminous Coal Stocks

	(Thousands of Net Tons) Oct. 1 1939	Sept. 1 1939	Oct. 1 1938
Electric power utilities	7,912	7,500	8,029
Byproduct coke ovens	6,220	5,632	5,952
Steel and rolling mills	573	542	638
Railroads (Class 1)	4,337	4,224	4,672
Other industrials†	11,187	9,526	10,085
Total	30,229	27,424	29,377

Bituminous Coal Consumption

	(Thousands of Net Tons) Sept. 1939	Aug. 1939	Sept. 1938
Electric power utilities	4,027	3,842	3,338
Byproduct coke ovens	5,517	5,177	3,770
Steel and rolling mills	766	719	652
Railroads (Class 1)	6,492	6,075	5,938
Other industrials†	8,181	7,624	7,418
Total	24,983	23,437	21,116

† Includes beehive ovens, coal-gas retorts and cement mills.

Fair Trade Code Sought By Hard-Coal Producers

The danger of depletion of anthracite as a natural resource is greater from bootleg mining and waste caused by incomplete mining of coal tapped than it is from exhaustion by complete mining in a scientific manner and in accordance with law, said the Anthracite Operators' Association in a statement made on Nov. 8 to the Federal Trade Commission. The statement was filed by W. S. Jermyn, chairman of the association's fair trade practices committee, in response to a request from the Commission, which has under consideration an application for a code of fair trade practices for anthracite filed by the association.

Provisions of the code, which will be embodied in an anthracite bill which it is proposed to introduce in the special session of the Pennsylvania Legislature in January, were discussed at a meeting of the association on Nov. 11 in the Scranton (Pa.) Club. Provisions of the bill include (a) immediate closing of bootleg operations so that their output can be figured in allocation tonnage; (b) establishment of an agency to post prices in market centers; (c) policing the measure by the State Department of Mines instead of by a commission, as in the Kane bill, defeated at the last session; (d) proper listing of old-line and independent companies for allocation. Alan C. Dodson presided as chairman at the Scranton meeting.

Bituminous-Coal Interests Ask Tax Relief

Tax-revision recommendations submitted in behalf of the bituminous-coal industry in a presentation on Nov. 14 to John W. Hanes, Under Secretary of the Treasury, by John D. Battle, executive secretary, National Coal Association, included advocacy of a pay-as-you-go policy for social security old-age benefits and a plea for permissive reductions in payroll taxes levied by the States for unemployment insurance. Other suggestions included repeal of the present 1c tonnage tax on bituminous coal imposed by the Guffey coal act, elimination of the so-called "unjust enrichment" tax as applied to coal, and retention of the optional percentage depletion allowance.

These recommendations, made in accordance with a general invitation by Under Secretary Hanes to business and industry to submit views and suggestions for improvements in the federal tax structure, also included: a requirement that employees as well as employers contribute to unemployment insurance costs; abolition of the capital stock tax; and restoration of the consolidated income return privilege.

"With the weekly output of bituminous

coal currently in excess of 10,000,000 tons," said Mr. Battle, "and with the labor cost per ton averaging not less than $1.27 — and probably more — the weekly payroll at the mines is at least $13,000,000 and probably more. Social security, unemployment insurance and workmen's compensation when levied upon payrolls so gigantic run into immense sums, and the question of the rate is of immense importance."

—◈—

Progressive Pact Scrapped By Kentucky Operators

Ten western Kentucky coal operators and the Progressive Mine Workers, District 5, have agreed to cancel a two-year closed-shop contract to settle a dispute with the United Mine Workers, according to an announcement on Nov. 11 by the National Labor Relations Board. The Board approved stipulations to the above effect and ordered secret collective-bargaining elections within 30 days so that employees may choose between the P.M.W. and U.M.W. as their representative.

The Board said the companies had agreed to issuance of a U. S. Circuit Court of Appeals consent decree requiring them to: (a) cease discouraging membership in the U.M.W. or encouraging membership in the P.M.W.; (b) disestablish the independent miners' union, an alleged company-dominated union with which the P.M.W. merged, according to the Board; (c) reinstate and offer back pay to all employees laid off because of the closed-shop provision requiring membership in the I.M.U. or the P.M.W.

The companies affected are: Empire Mining Co., Norton Coal Corporation, Williams Coal Co., Hart Coal Corporation, Newcoal Corporation, Flat Creek Coal Co., Lick Creek Coal Co., Dawson Daylight Coal Co., Ruckman Coal Co. and Dawson Collieries, Inc.

—◈—

Britain Forms Buying Board

A central organization to be known as the British Supply Board is being set up by the United Kingdom Government in Canada and the United States to coordinate purchases in the two countries. Col. J. H. M. Greenly has been appointed controller general and chairman, and Sir James Rae is deputy controller general and vice chairman, with headquarters in Montreal.

The Board will place orders in Canada through the Canadian War Supply Board recently set up by the Canadian Government under the chairmanship of Wallace Campbell. Orders in the United States will be placed through a British Purchasing Commission in charge of Arthur B. Purvis, who has been appointed director general of purchases (United States). Mr. Campbell and Mr. Purvis will be members of the central organization, which also will include representatives of the United Kingdom Service Departments and His Majesty's Treasury. An announcement is to be made later regarding the necessary arrangements to secure close coordination of British and French purchases in the United States.

Maintenance and Mining Problems Studied At Illinois Institute Meeting

WITH maintenance heading the list, Illinois mining men tackled also the problems of blasting, compensation laws and the future of the State's coal industry at the 47th annual meeting of the Illinois Mining Institute, Hotel Abraham Lincoln, Springfield, Ill., Nov. 10. Tom Moses, retired vice-president in charge of raw materials, United States Steel Corporation of Delaware, and Eugene McAuliffe, president, Union Pacific Coal Co., were presented with certificates of honorary life membership at the annual banquet, with Paul Weir, retiring president of the institute, as master of ceremonies. The institute signalized B. E. Schonthal's ten years as secretary-treasurer by presenting him with a set of crystal glasses in appreciation of his services.

Because of wide variation in equipment and operating conditions, no locomotive-maintenance procedure would be practicable for all mines, stated Hector Hall, chief electrician, Zeigler No. 2 mine, Bell & Zoller Coal & Mining Co., in opening the morning session, sponsored by the Mining Electrical Group, with its past president, A. L. Reed, chief electrician, No. 18 mine, Peabody Coal Co., West Frankfort, presiding. However, said Mr. Hall, with few exceptions all locomotive maintenance can be handled as routine work by rigid adherence to a specific procedure such as:

"1. Having no motorman report direct to the repairman.

"2. The replacement of parts as a unit by the night-shift repairmen.

"3. The repairing of replaced units by day-shift mechanics.

"4. The systematic check of locomotives and lubrication.

"5. The rotation of locomotives through the shop."

There are 46 locomotives to be serviced. All routine repair work reported by the day shift is done on the night shift by four maintenance men who also thoroughly inspect two gathering locomotives each shift. Two other repairmen inspect one gathering and one haulage locomotive and also attend to repairs reported by the night-shift motormen, but concentrate on the haulage locomotive, as it is routine schedule. Locomotive lubrication is the responsibility of another night-shift man. Axle caps and journals are oiled every other night; armature bearings on the light locomotives are greased every three months, and on the haulage locomotives each month.

Heavy Work Done On Day Shift

All heavy work is done by two men on the day shift and, as an extra locomotive is available, such repairs do not affect mine operation. A coat of aluminum paint is given each motor before leaving the shop. Journal boxes with set of trucks are kept assembled. A safety feature is the ground patented control used on four locomotives. A complete steel-strip-type resistance is kept mounted as a unit and bolted in place in front end of locomotive. A circuit breaker is installed instead of a fuse when a locomotive is overhauled. All mechanically driven reels are being replaced by electric reels, using Class "B" insulation throughout on the reel motors. Each locomotive is equipped with two trolley poles and a headlight on both front and rear. Resistance for lamps is space-heater type and lamps have single-pole double-throw switch, so either lamp may be lighted at will. A metal windshield, quickly raised or lowered, is standard equipment on gathering motors. Both new and built-up tires are used, but whether a saving is made by building up tires with arc-welding is a question, as the welded tire gives about one-half the service of a new tire.

Before complaining about high power rates first check power factor, cautioned A. G. Shaffer, chief underground electrician, Chicago, Wilmington & Franklin Coal Co., West Frankfort, and remember that the State commission fixes the rates. Power losses occur in many ways and it often takes some time to locate the fault, during which interval great losses may take place. One method of protection against undue losses is by sectionalizing, which means that when trouble develops the various sections of the mine may be cut off the power line without disturbing production in the other sections. Advantages are that the system is broken up and voltage disturbances are minimized. Most power disturbances occur near the face, so it is there that sectionalizing switches should be installed—not on

ILLINOIS INSTITUTE HEADS

Roy L. Adams, general superintendent, Old Ben Coal Corporation, West Frankfort, was elected president of the Illinois Mining Institute at the 47th annual meeting, in Springfield, Nov. 10. Dr. M. M. Leighton, chief, Illinois Geological Survey, Urbana, was chosen as vice-president, and B. E. Schonthal, president, B. E. Schonthal & Co., Chicago, was again elected secretary-treasurer.

Members of the executive board are: J. G. Crawford, general manager, Valier Coal Co., Chicago; A. F. Dodd, general superintendent, United States Fuel Co., Danville; M. M. Moser, vice-president, United Electric Coal Cos., Chicago; James McSherry, director, Department of Mines and Minerals, Springfield; and B. H. Schull, vice-president, Binkley Mining Co., Terre Haute, Ind., to serve for one year; D. H. Devonald, assistant to vice-president, Peabody Coal Co., Chicago; L. D. Smith, vice-president, Chicago, Wilmington & Franklin Coal Co., Chicago; L. A. Wasson, assistant general manager, Wasson Coal Co., Harrisburg, and W. P. Young, vice-president, Bell & Zoller Coal & Mining Co., Pekin, to serve for two years; and G. S. Jenkins, general superintendent, Consolidated Coal Co., St. Louis; Fred Miller, assistant to the vice-president, Franklin County Coal Corporation, Herrin, and D. D. Wilcox, general superintendent, Superior Coal Co., Gillespie, for three years.

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and
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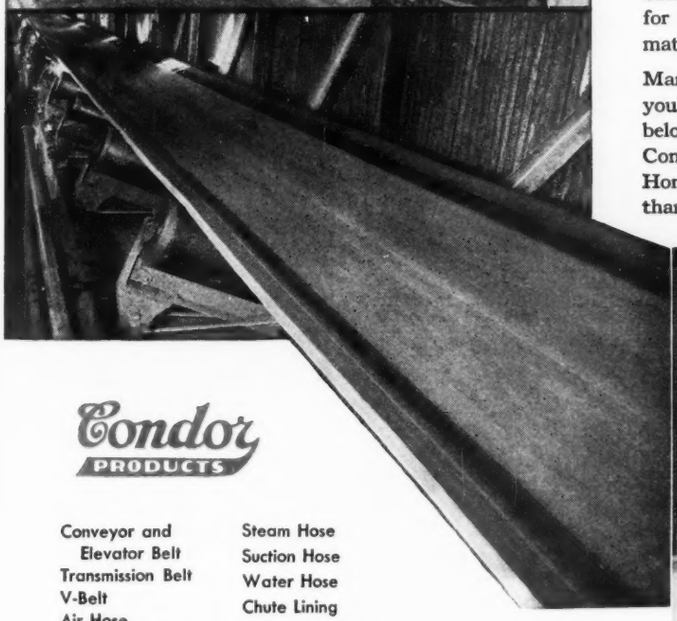

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BURNING and electrocution hazards from accidental contact with mine trolley wires are prevented in coal and metal mines by the use of the patented Condor Trolley Wire Guard—a flexible, pliable reinforced rubber trough with high voltage resistance.

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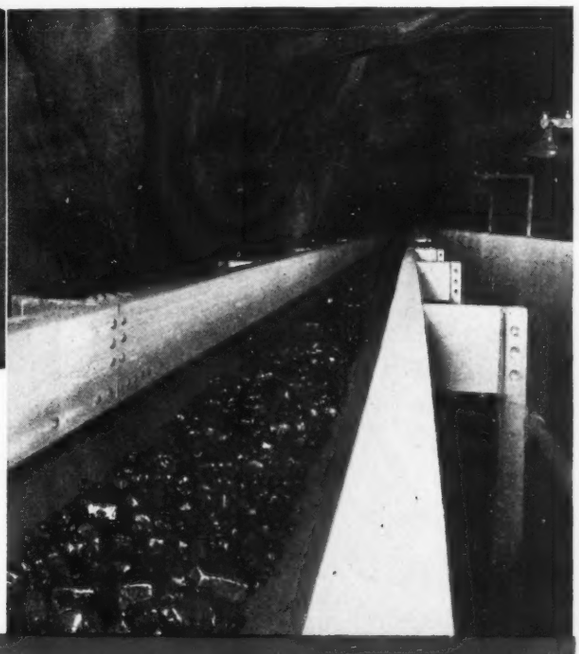
Manhattan engineers will fit the belt to the task for you so that you may enjoy a high return in low-cost transportation above or below ground. There's more information in Bulletin 6862 on Conveyor Belts and it's worth writing for. Ask about the Condor Homo-Flex Belt, the belt that sells itself on performance rather than on specifications.



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Eugene McAuliffe acknowledges honorary life membership.

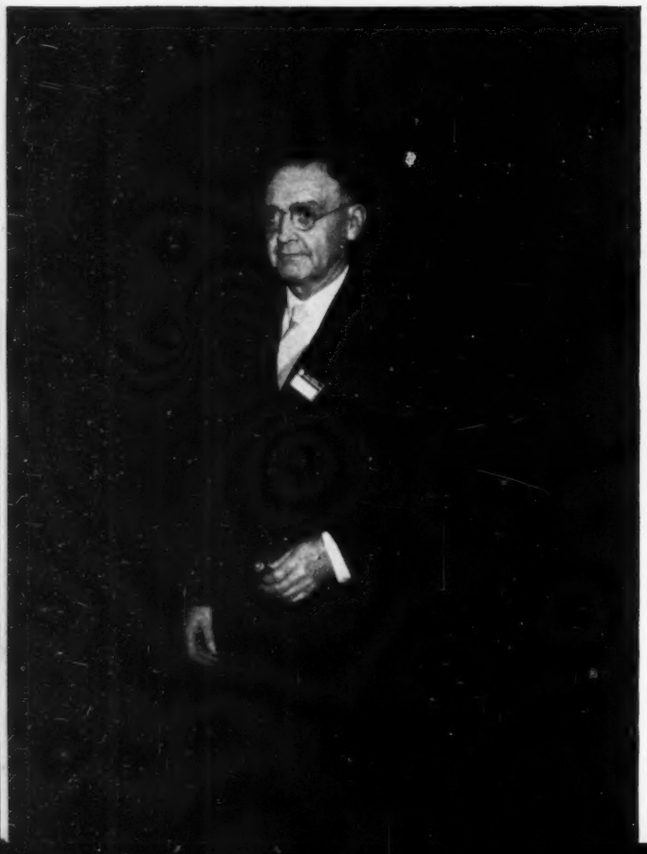
Is coal sold?
Norvin H. Vaughan was doubtf

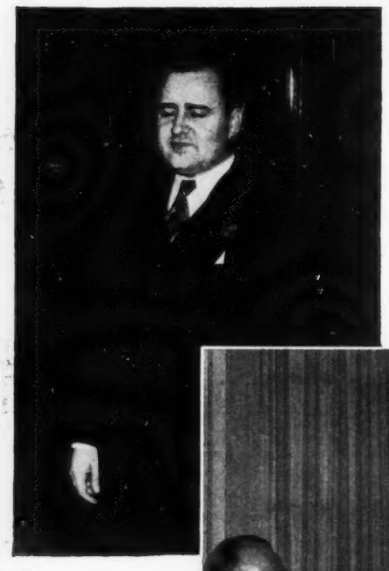
Southern Illinois delegate
J. G. Crawford thinks it over

Roy L. Adams
President-elect, Illinois Mining Institute.

Geologists huddle
L. C. McCabe and Don L. Carroll.

Between sessions
John E. Jones looks around.





C. C. Conway
New president,
Mining Electrical Group.

Secretary-treasurer surprised
B. E. Schonthal receives crystal set—admired by
T. J. Thomas.

COAL MERCHANDISING?

"Economies in the use of its product cannot alone explain away the loss, by any industry, of 40 per cent of its position in the national economy in the last 25 years. . . . Let's face the facts . . . the coal industry as a whole thus far has done a poor job of merchandising. . . . This fall, I moved into a northern Chicago suburb and the vans had hardly driven away before I was courteously and efficiently solicited by the oil and gas men . . . even by the garbage man . . . but to this day have not heard even a whisper from a single coal man. And I am reliably informed that this is characteristic the country over. . . . Talk about selling coal in the summer-time—I'm not so sure the industry knows how to sell it in the winter-time!"—Norvin H. Vaughan, at the Illinois Mining Institute meeting, Springfield, Nov. 10.

main-line haulage, which is affected only by overload. Another advantage is that quite often a ground will not trip a large central breaker, but the smaller section breaker will be affected, thus eliminating a power loss. Through proper sectionalizing, daily production and efficiency will be increased and the power cost lowered.

Maintenance of loading machines, C. C. Conway, chief electrician, Consolidated Coal Co., said, should be considered at the time of purchase. For example: a loading machine so large that it scrapes the top probably will result in a high maintenance cost for conveying parts, whereas if the machine is too small and light, the maintenance cost again will be high. Permissible equipment, from the standpoint of maintenance and safety, has advantages over open-type equipment in that motors and wiring are better protected.

Regardless of the age of the machine, operating conditions, or any other factors, maintenance and repair must be inaugurated in order that they have a minimum of breakdowns and low maintenance cost. Many operators place one or more repairmen in each territory to make necessary day-shift repairs and actual maintenance is accomplished on an off-shift through reports from both machine operators and day repairmen. The overhauling is done at a central shop, usually located on the shaft bottom, but the working territories of the Consolidated mines are concentrated into a small section and a central shop is maintained there. No repairmen are stationed in the territories but remain in the central shop subject to call at any time. Loading-machine operators and day repairmen file reports at the end of each shift for the guidance of maintenance men on the off-shift.

"Proper lubrication is necessary in the maintenance of loading machines and, conversely, loading machines can be properly lubricated only when they are well maintained," said Mr. Conway. With the machines in a small area it is found practical to have oilers confine their time to lubrication, so that maintenance men are free to spend a maximum of time on repair work. Both a repair and maintenance-man report (including lubrication) should be made on every loading machine at the end of each shift. "Practically every company that is credited with having an efficient maintenance system also has an efficient system of records." Questioned by Chairman Reed, Mr. Conway said that his company used grease trucks which carried tools, greases and oils, but had no pumps.

As chairman of the committee on scientific studies of physical conditions and improved practical analysis of the hazards of coal bed and adjacent strata which affect safety in Illinois, J. E. Jones, safety engineer, Old Ben Coal Corporation, West Frankfort, reported that something must be done about roof falls, as 55 per cent of accidents are of this type. Mr. Jones followed this with a motion the institute appropriate $5,000 for a fellowship to be used for studies of roof falls.

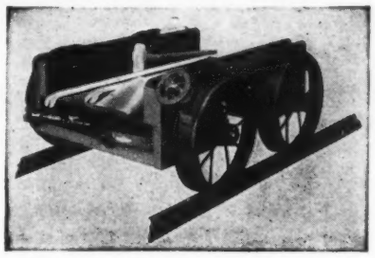
That the institute did not have $5,000 available for such purposes was pointed out by Mr. Weir. T. J. Thomas, president, Valier Coal Co., asked if such studies were being made by the U. S. Bureau of Mines, to which J. J. Forbes, supervising engineer, Pittsburgh Experiment Station, replied that such work was under way several years ago but was discontinued in 1933, when funds were cut. The Bureau is back of such study to the best of its ability and Mr. Forbes recommended that the committee approach the director. Accordingly, the motion was withdrawn and another passed that Mr. Jones or some other member of the committee visit the director, at the expense of the institute, to obtain the Bureau's support.

Results of a meeting with representatives of the Illinois Department of Mines and Minerals and the U. S. Bureau of Mines were reported by Mr. Weir at the start of the afternoon session, presided over by R. L. Adams, general superintendent, Old Ben Coal Corporation, West Frankfort. The meeting was devoted to bringing about district and State safety meets, which I. M. I. officers felt would be effective in reducing accidents. Upshot of the discussion was appointment of James McSherry, director, Department of Mines and Minerals, Springfield; C. A. Herbert, supervising engineer, U. S. Bureau of Mines, Vincennes, Ind.; and Mr. Adams to a committee to (a) work out a program to bring about such meets; (b) develop a plan for closer cooperation between I. M. I. and the coal-mining engineering department of the State university and (c) study the possibility of

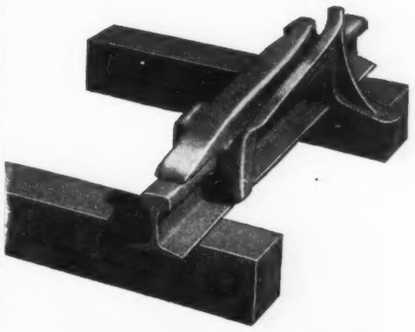
Coming Meetings

- Coal Mining Institute of America: fifty-third annual meeting, Dec. 14 and 15, Fort Pitt Hotel, Pittsburgh, Pa.
- International Heating and Ventilating Exposition: Jan. 22-26, Lakeside Hall, Cleveland, Ohio.
- Pocahontas Electric and Mechanical Institute: annual meeting, Jan. 26, Bluefield, W. Va.
- American Institute of Mining and Metallurgical Engineers: annual meeting, Feb. 12-15, Engineering Societies Building, New York City.

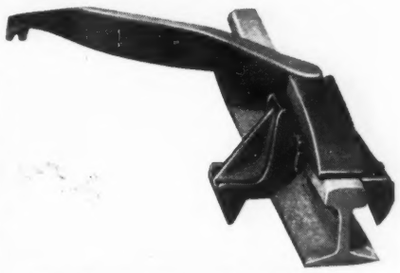
Slash Your Costs With GEMCO Tru-Blu Tools



Drillers & Trackmens Tool Car



Derailers Will Save Lives



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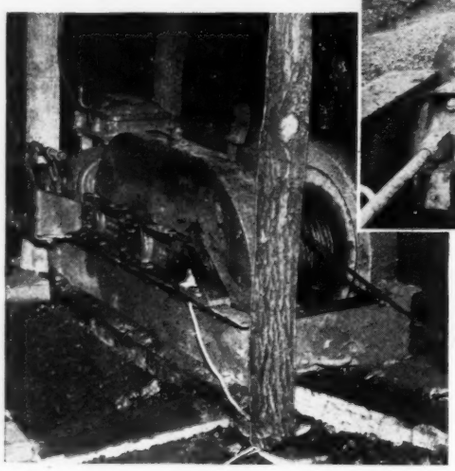
HELPS MODEL MINES MAKE MORE MONEY...

Brown-Fayro hoist, moving cars backward and forward for uniform loading of coal, at Federal No. 3 Mine, Koppers Coal Company.



Brown-Fayro's permissible car spotting hoist handles 3 ton cars from shuttle car loading station to main line haulage road. Mine No. 25, Consolidation Coal Company.

● From working face to tipple; above ground and below; all along the line, Brown-Fayro coal mining equipment is constantly lowering costs for mine operators everywhere. Almost every operation, from mining through coal preparation, can be made more profitable by utilizing Brown-Fayro machinery. Both the units shown here have the profit-promoting characteristics of economy, power, and dependability for truly *modern* mechanized coal mining. All Brown-Fayro hoists, pumps, blowers, mine cars, wheels, and other varied products, are manufactured to meet your specific requirements successfully.

Why not let Brown-Fayro make more money for *you* all along the line? Write today to get your *free* copies of the latest literature on the Brown-Fayro line, designed and built especially for the Coal Mining Industry.

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vocational education through night-school training.

Proper timbering is one solution of the problem of top falls, said Mr. McAuliffe. Dependence should not be placed on sounding the top because with mechanized mining there is too much counter-noise. All accidents are of great concern to the Union Pacific Coal Co., and today its records show one accident to eight of several years ago, so the plan must be good. Several years ago the accident rate was one in 15,973 man-hours of exposure; last year, one in 103,172 man-hours; and to date this year, one in 125,300 man-hours. Interest on the part of the men was aroused through a lottery arrangement whereby two autos were awarded every six months and each man without an accident had a chance. No distinction is made between fatal and non-fatal accidents, as the difference between one and the other usually is only a matter of seconds. There have been only 22 lost-time accidents this year, one fatal. When safety is practiced, efficiency is increased, which may mean the difference between profit and loss to the operator.

Blasting Practices Differ

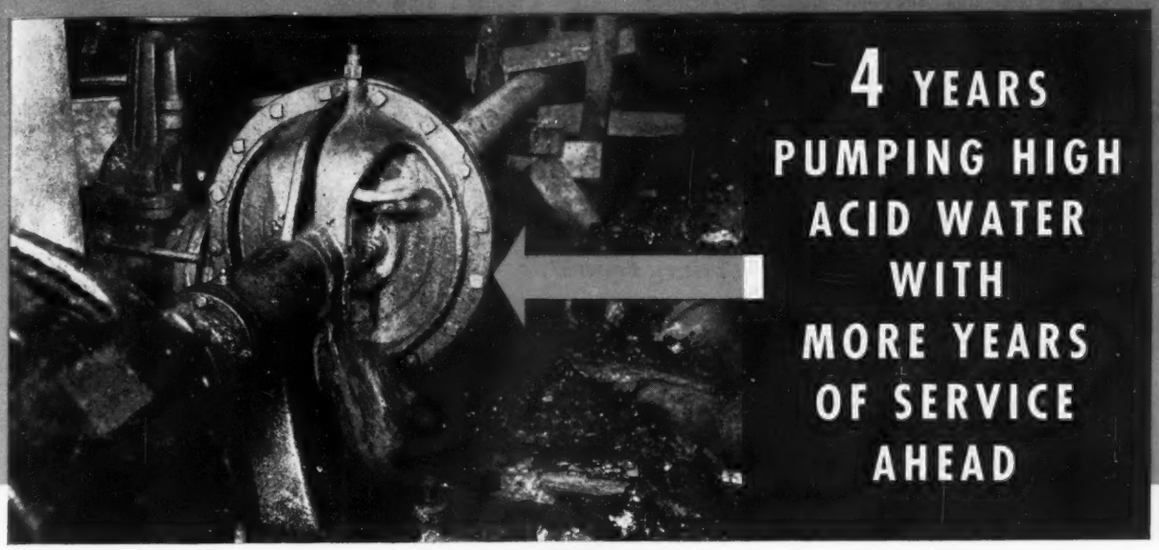
Noting how blasting practices differ in various localities, J. L. Romig, technical engineer, Atlas Powder Co., Wilmington, Del., resorted to the laboratory, determining the reasons for the success of some practices over others. However, he continued, it must be understood that many practices are good for only one set of conditions. Safest methods are best. Supervision is the keystone of safety because the best plans fail when the executive will to safety and efficiency gets lost at the face.

The physical properties of the material to be blasted are of fundamental importance in determining the correct explosive and method of blasting, stated Mr. Romig. Careful observation and study are needed to make the proper selection. However, even after an explosive has been selected, difference of opinion may develop regarding the merits of that grade. These differences often resolve into certain specific operation or safety problems. For example, the work an explosive does is influenced to some degree by some or all of the following factors: (1) diameter of cartridge, (2) loading procedure, (3) drillhole diameter, (4) stemming and tamping, (5) cutting methods, (6) bug-dusting, (7) cushioning or space-shooting and (8) the method of priming.

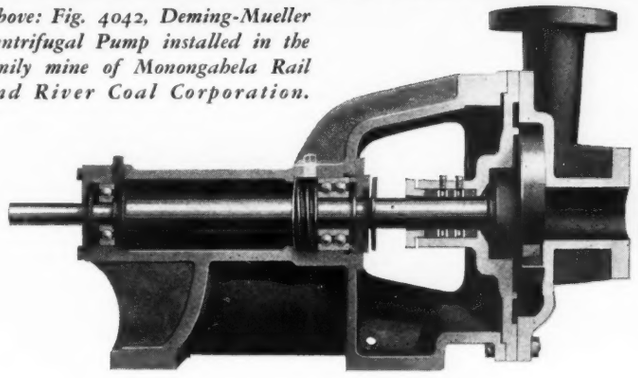
Cartridges larger than the basic 1¼x8-in. size permit concentration of more charge at the back of hole, stand up better under long storage and are more sensitive. However, numerous tests show that velocity of all explosives increases when diameter of cartridge is enlarged and also when confined. "The rate of increase," said Mr. Romig, "depends upon the grade and all grades do not show the same rate of increase." When cartridges are slit and tamped they will shoot differently from when loaded intact. The slit cartridge, in effect, is increased in diameter and confinement so that the same explosive used in the same mine but loaded differently often produces coal which looks as if shot with two different grades.

Varying hole diameter will affect blasting because if depth is constant the vol-

PROOF that DEMING Pumps can help to cut YOUR costs!



Above: Fig. 4042, Deming-Mueller Centrifugal Pump installed in the Emily mine of Monongahela Rail and River Coal Corporation.



This Separate Water End Construction Saves You Money!

● FOUR YEARS pumping highly corrosive acid water and still going strong is the record to date of the Deming-Mueller Side Suction Centrifugal Pump illustrated. Four years equals 35,040 hours. Match that against the 24 hours required for the same water to eat through a new cast iron power head replaced by the Deming Pump with water end of special corrosion-resisting alloys.

The outstanding feature of this pump is the liquid end, which consists of the casing, impeller and stuffing box head, separate and bolted to the rigid support head or power end. For pumping corrosive liquids, therefore, only these liquid end parts need be made of alloys, while the support head can be of cast iron construction, thereby effecting a great saving in the first cost and future repairs.

Write for illustrated Bulletin 4200 which contains complete data.

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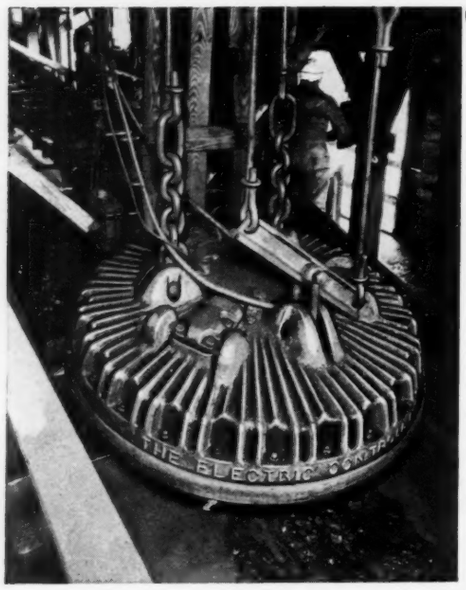
DEPENDABLE PUMPS FOR LOW COST MINE DEWATERING SERVICE



The Largest Coal Producers use

EC&M MAGNETS

for Tramp Iron Protection

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HEAVY DUTY MOTOR CONTROL FOR CRANES, MILL DRIVES AND MACHINERY • BRAKES • LIMIT STOPS • LIFTING MAGNETS AND AUTOMATIC WELD TIMERS.

● Pictured above is a 65-inch EC&M Separator Magnet installed in a WEST VIRGINIA mine for removal of tramp iron before the coal goes through the washing process. In this mine as well as in many other prominent coal mines, EC&M Separator Magnets are selected not only to prevent damage to crushing equipment but also to provide a product free from tramp iron . . . the trouble maker. Illustrated Bulletin 910-C shows how these powerful magnets may be installed directly above a conveyor or mounted at an angle over the head pulley at the discharge end of a conveyor. Data on sizes, separation, etc. also included. Write for your copy to-day.

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Eliminates hand switches. No shocks or burns. Simple, safe, efficient, easy to install, mounted anywhere. Ohmstone base defies moisture and creepage. For 250 or 550-Volt service in single or double trolley and reel.

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ume varies as the square of the diameter. As a result a cartridge in too large a hole has an air space between it and the coal and effect of the blast is cushioned and confinement lessened, decreasing velocity of charge. Tamping bags too small in diameter and too long telescope or collapse when tamped so that only 4 or 5 in. of the hole is compacted and the remainder is practically untamped, which may cause unintentional cushioning and improper confinement of the charge. Proper stemming is of great importance in: (1) preventing blown-out shots and the possible projection of flame and hot gases into the surrounding atmosphere, (2) keeping fumes to a minimum, (3) decreasing quantity of explosive needed to do the work and (4) keeping the quantity of fine dust thrown into air at a minimum.

Finding that their royalties were in direct proportion to the quality of the coal produced, a coal-land company, Mr. Romig stated, made an investigation which showed that lump-coal percentage could be increased by correct cutting, removal of all bug-dust, proper placement and diameter of holes and cushioned blasting. Irregularly cut places make it almost impossible to locate drillholes correctly to produce a maximum of lump coal. A cut partly filled with bug-dust is likely to prevent the coal from breaking down and rolling out properly, which usually necessitates hand-mining and means degradation. Ash content also is likely to be higher in uncleaned cuts.

Cushioning reduce shattering and is a direct means of more or less controlling the explosive action. There are several methods, one of which is to use a cartridge much smaller than the hole. Another is to use some mechanical means of supporting the cartridge so that it is not in contact with the coal. Sheathed permissibles (being experimented with by explosive companies) are explosives sheathed with an inert material that adds greatly to the safety of fixed explosives; cuts down both temperature and flame, and provides a certain amount of cushioning which is helpful in producing quality coal.

Unemployment Act Debated

Will the advantages of continuous operation be offset by the possible costs of securing it? asked Norvin H. Vaughan, district sales manager, Consolidated Coal Co., Chicago, in discussing the new Illinois Unemployment Compensation Act. It should be pointed out that in other States where unemployment compensation is in effect, it has been found that where formerly some of the miners sought agricultural work in summer months, these men now draw partial unemployment compensation insurance and the farmers are confronted with a shortage of help.

Authorities say that if sales departments can provide enough business to operate our mines three days per week through the summer months the problem will be solved. The excess winter production (October-March) over summer production (April-September) was: 50.3 per cent for Illinois and 15.2 per cent for the United States in 1929; 35.9 per cent and 12.2 per cent for 1931; 61.4 per cent and 27.1 per cent for 1934; 68.1 and 27.9 per cent for 1936; and 55.3 and 28.8 per cent for 1938. Since in the past, summer operation of three days per week

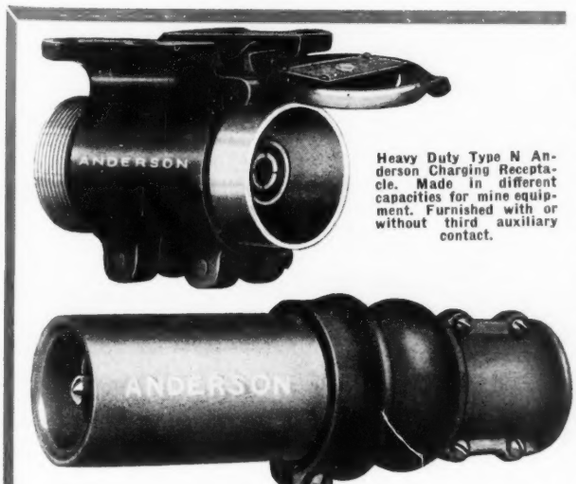
LONG, SAFE SERVICE at Lowest Cost...

Showing the A. & J. M. Anderson charging plugs in use for the new Philco permissible storage batteries used in the Joy shuttle cars which were recently placed in service in connection with mechanical loaders in Mine No. 25 of Consolidation Coal Company.

ANDERSON

PLUG and RECEPTACLE CONNECTORS

—are in use on two outstanding mechanized mines of northern West Virginia. . . . Mine 25 of the Consolidation Coal Company, of Clarksburg, and the Rachel Mine of Jones Collieries, Inc.



Heavy Duty Type N Anderson Charging Receptacle. Made in different capacities for mine equipment. Furnished with or without third auxiliary contact.

Heavy Duty Anderson Charging Plug. Made in various capacities for mine equipment.

Built to withstand abuse and rough handling, these plug and receptacle connectors assure long, safe operation—one type having been approved by the U. S. Bureau of Mines for use with "Permissible" mining equipment.

Other Anderson Mine Products include: Air-Flow Relays for mine ventilation control—Heavy Knife Switches—Circuit Breakers — Insulators — Automatic Time Switches—Overhead Line Material.

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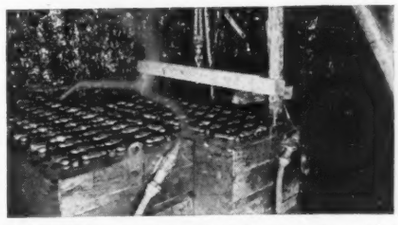
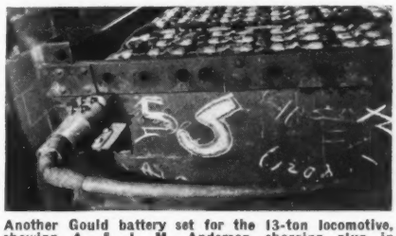


Exide 200-amp. hr. storage batteries being charged for the next shift of Joy shuttle cars which are loaded by Joy loaders in Laura Lee Mine. A. & J. M. Anderson charging plugs are shown in use to lift the batteries out of the car to charging location and back into car after they are charged.



Another Gould battery set for the 13-ton locomotive, showing A. & J. M. Anderson charging plug in service, in Rachel Mine of Jones Collieries Company.

ALBERT & J. M. ANDERSON MFG. CO.
289-305 A ST., BOSTON, MASS.
NEW YORK CHICAGO PHILADELPHIA BUFFALO LONDON

has not been accomplished it is obvious that old methods will not suffice and something new must be tried. Inquiry among key men in most of the coal-producing States indicated that about the only methods used to stimulate summer buying were: (a) cut prices at the mines; (b) cut prices by the retail dealers; and (c) advertising and sales programs, all of which met with varying degrees of success.

Since solution of the problem calls for large-scale cooperation, Mr. Vaughan suggested that the Public Service Division of the Illinois Coal Operators' Association be created to:

1. Get State and federal organizations and subdivisions to purchase coal in the thin months.

2. Go after the many political bodies in Illinois, the school boards, county commissioners, public hospitals, etc., and have them buy coal mined in the State.

3. Give wise counsel to the army of salesmen who now work under probably as many different ideas as there are companies. Sort out the mass of material and analyze new trends and developments. Interpret the signals of the future and try to determine where we are going, how and why.

Nearly every industry must meet the problems of retreating markets, pointed out Dr. Clayton G. Ball, consulting engineer, Chicago. The best field for reducing operating costs is after the coal has left the face. That very little can be done before this time is indicated by the fact that 87 per cent was mechanically loaded in Illinois last year. Borehole records indicate that untouched reserves probably are thinner than present mined beds, are of poorer grade, and have bad top. Therefore it is unlikely that lower costs will result by mining these beds. However, new stripping equipment undoubtedly will be developed to mine some of this coal.

Flexibility to meet the various requirements has increased the trend toward prepared coal, and in 1938 52.9 per cent of State production was mechanically cleaned. The preparation process develops different characteristics in different sizes and the future of preparation is the ability to create a prepared product such as is required by the domestic stoker. High sulphur content and weak structure have ruled out the metallurgical use of Illinois coal but it does coke and a method may be developed to eliminate the smoke. There already is a process of preparing coal before coking by which sulphur and ash may be minimized. Progressing to a point where coal is purchased because of its particular adaptability to some definite use will help sales. In such a manner coal would be sold because of definite advantageous qualities to a specific use not because of locality of mine.

—◈—

Seymour Washhouse Destroyed

The washhouse of the Seymour Coal Mining Co., Herrin, Ill., was destroyed by fire early in the morning of Nov. 1. A fireproof structure will be erected to replace the old one as soon as arrangements can be completed, according to Frank H. Seymour, superintendent.

Rail Welding and Gathering Methods Highlighted at West Virginia

COMBINATIONS of mechanical loading and secondary haulage, power supply including rail welding and specific problems in mechanical cleaning were discussed at the technical sessions at the 32d annual meeting of the West Virginia Mining Institute, Morgantown, Nov. 10 and 11. Machine mining, said Jesse V. Sullivan, secretary of the West Virginia Coal Association, speaking for radio broadcast at the banquet, is a healthy development which has kept mines in production that otherwise would have succumbed to competition. "Obnoxious legislation" and "just another move on the part of labor to harass the industry," were his characterizations of the proposals for federal inspection of mines. A resolution adopted by the institute deplored the provision of the Venezuelan reciprocal trade treaty reducing the excise tax on Venezuelan oil from ½ to ¼ c. per gallon.

That rubber-tired shuttle cars are to be put into 36- to 40-in. coal seams in eastern Kentucky was brought out in a discussion following the showing of Kodachrome movies by Arthur Knoizen, Joy Mfg. Co. Preliminary to the feature attractions, consisting of rubber-tired equipment in action, he showed the Joy Junior loading 36-in. coal into conveyors in the No. 3 Elkhorn seam, Garrett, Ky., and the 8BU working in the 5-ft. Winifrede seam at Cinderella, W. Va. This film included close-ups of coal faces being blasted with Cardox. Mr. Knoizen explained that the camera was actually 200 ft. from the face and a telephoto lens was used.

Rubber-tired shuttle-car "secondary haulage" from 8BU machines was shown in 46- to 48-in. coal of the Eagle seam and also in 42- to 44-in. coal at the Gay Coal & Coke Co., Mount Gay, in Logan County. These shuttle cars are powered with Exide-Ironclad batteries and carry 3½ tons. Over-all dimensions are: height, 32 in.; width, 6½ ft., and length, 20½ ft. The final reel showed a Joy 11BU loading into a Joy 6-ton rubber-tired shuttle car in a Pittsburgh-seam mine in northern West Virginia. Philco batteries are used on these cars. Answering an inquiry by F. F. Jorgensen, the speaker said that some work is now being done in the development of cable reel instead of battery power for the shuttle cars and in four-wheel steering.

Experience with a shuttle-car unit in the Laura Lee mine of the Hutchinson Coal Co. (see p. 51 of this issue) was discussed by Glen Toothman. After pointing out that the management, power and other problems seem to increase as the square of the production attempted from a unit, he enumerated the several difficulties that dog the system. One of these is lack of capacity of one cutting machine to cut for one unit, thus requiring two machines or additional cutting during an off-shift.

Shuttle-Car Idea Good

"Bugs are overcome in the mine and not on the drafting table," said W. J. Wolf, general manager, Consolidation Coal Co., when invited to discuss the rubber-tired haulage with which his company has had some experience (see p. 51 of this issue). In his opinion, the idea of the new system is basically very good, and in cooperation with the manufacturers the difficulties will be ironed out.

Peak tonnages of 28 and 39 per man were cited for another type of trackless mechanical mining, duckbills and shaker conveyors, in the western Kentucky field, in an illustrated paper written by D. M. Duncan, Goodman Mfg. Co., and read by G. F. Hall. In that field, where, generally speaking, the grades vary from plus 10 to minus 10 per cent and bottom is a soft fireclay, the use of duckbills and shakers dates from 1936. Pillars are not being taken in any of the installations made to date. At first, the shaker units were used singly, but the present method is to use two or more delivering to flight or belt-type gathering conveyors.

Change of system from a two-heading to a three-heading room entry raised performance 11 per cent. Track is maintained only in the center heading and three conveyors and duckbills working in rooms to one side deliver to a common loading point. Time studies show that the greater the overlap in face preparations—for instance, starting the cutting before loading is finished—the greater is the efficiency and the tonnage. A half shift, equal to 14 man-hours, is normal for moving a duckbill and pan line to a new room. The shaker drive is dragged with the cutting-machine rope.

The production of 38 tons per man-shift is an average for half a month in a mine of the Rogers Brothers Coal Co. and that figure includes the boom man. At another mine in western Kentucky

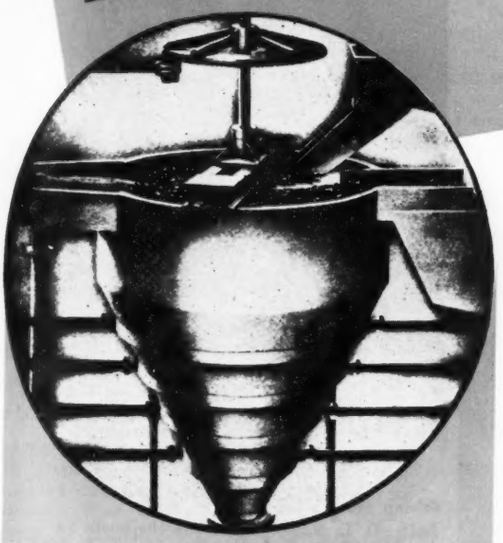
NEW INSTITUTE OFFICERS

C. W. Connor, general superintendent, Nellis mine, American Rolling Mill Co., Nellis, was elected president of the West Virginia Coal Mining Institute. He succeeds F. F. Jorgensen, manager of operations, Monongahela Rail & River Coal Corporation, Fairmont.

Vice-presidents—W. J. German, general superintendent, Pocahontas Fuel Co., Pocahontas, Va.; Walter G. Crichton, general manager, Johnstown Coal & Coke Co., Charleston; T. E. Johnson, vice-president, Hutchinson Coal Co., Fairmont; John T. Sydnor, vice-president, West Virginia Coal & Coke Corporation, Omar; and M. H. Forester, manager, West Virginia division, Consolidation Coal Co., Fairmont.

Executive Board—E. B. Agee, superintendent, Youngstown Mines Corporation, Dehue; R. J. Burmeister, general manager, Raleigh Coal & Coke Co., Raleigh; R. E. Salvati, vice-president and general manager, Island Creek Coal Co., Holden; Carel Robinson, consulting engineer, Ward; N. P. Rinehart, chief, West Virginia Department of Mines, Charleston; and F. F. Jorgensen.

Secretary-Treasurer—Prof. D. L. McElroy, director, School of Mines, West Virginia University, Morgantown.



FAIRMONT BUILT PLANTS ARE LOW OPERATING COST PLANTS

●FAIRMONT built preparation plants contribute to low costs in Northern West Virginia. Above left is photo of tipple and preparation plant of the Dawson Coal Company. Above right is photo of the tipple and Chance Sand Flotation System cleaning plant at Pursglove No. 15 Mine.

If you have a coal preparation problem involving coal handling, screening, loading, or cleaning, let our engineers confer with you. FAIRMONT Engineers, with the Chance Sand Flotation System of coal cleaning at their disposal along with an exceptionally well designed line of screening and conveying equipment, can design and construct for you the best to be had in a low operating cost preparation plant.

In collaboration with United Engineers & Constructors Inc., of Philadelphia, we are prepared to offer complete Bituminous Coal Preparation and Chance Sand Flotation Washing Plants.

TRADE MARK REGISTERED

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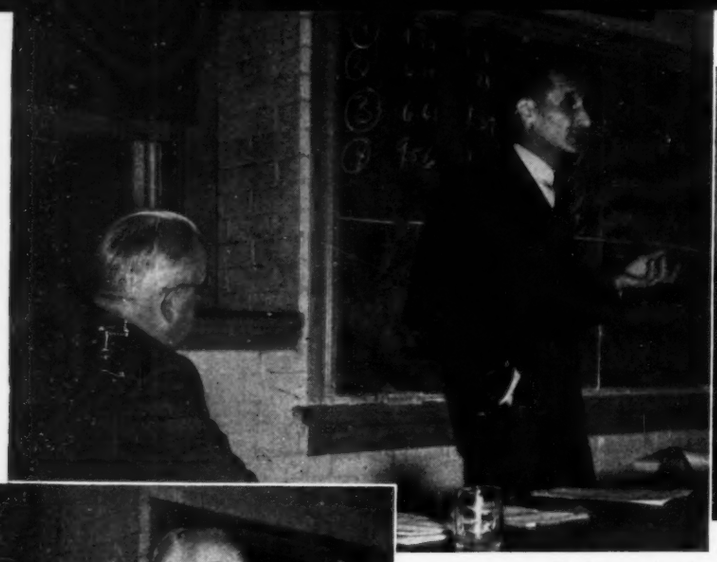
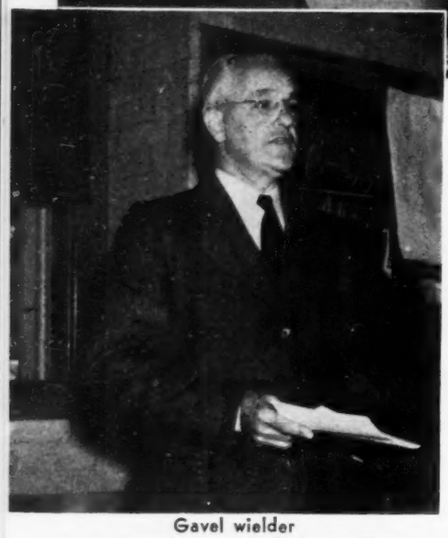


"Can we afford to reduce?"
M. W. Forester discusses extraction.

Sampling the noon breezes
L. E. Young, M. D. Cooper, H. L. Griffin and M. W. Forester try the outdo



Gavel wielder
C. W. Connor, new institute president, presides at afternoon session.

"Get what we put in"
F. F. Jorgensen, retiring president, calls first session to order.

"Here are some figures"
Joseph Pursglove, Jr., analyzes mechanical-cleanin advantages.

Giving them a job
Left—D. L. McElroy presents the books to M. W. Horgan, J. R. Cameron and E. B. Agee, auditing committee members.

Banqueteers
Bottom left—Jesse V. Sullivan broadcasts while C. W. Connor, new president, and F. F. Jorgensen, ex-president, listen. At right—R. M. Davis and A. W. Hawley await their victuals.

using duckbills and shakers in 4-ft. 10-in. coal, working the three-heading and three-room set-up with an 11-man crew produces 29.6 tons per man excluding the foreman and an electrician. In this mine, rooms are driven 30 ft. wide on 36-ft. centers and the actual loading time is 50 per cent of the total. Answering a question, Mr. Hall explained that the inches of advance per stroke for the three sizes of duckbills are 7¼, 8, and 9, respectively.

At the Hitchman Coal & Coke Co., Wheeling, W. Va., 18 to 20 tons per man has been achieved for "two or three set-ups at a time" in driving entry with duckbills and shakers, the first of which were installed last August, said P. G. Carroll, of that company. Of the nine shakers now in use, five are in entries and four in rooms. Using three units, and with the haulage track in the center one of the three headings, an entry is advanced 250 to 300 ft. in a week with three-shift work, and near the end of each week's advance the two chain pillars are penetrated with breakthroughs for the next set-up, which is made on Sunday. Coal is 5 to 5½ ft. thick and 6-ft. cutter bars are used.

Bogey 20 Tons Per Man

Four shakers working in a room mining set-up are without duckbills but are to be equipped with them soon. Twenty tons per man has been the bogey in this room work, in which a flight conveyor, first used for gathering, has been replaced with a belt. Preparing the coal for the duckbill—that is, getting it down on the floor—is the real job, in the opinion of Mr. Carroll. Loading and conveying to the car are the least worries. With new men, some trouble was experienced in keeping pans in proper alignment, but with trained crews that difficulty disappears.

Screening and rejecting 20-mesh x 0 material proved the solution of a particular problem confronting the West Virginia Coal & Coke Corporation at its No. 4 mine when market conditions required a prepared stoker coal devoid of the 5/16x0 and the latter proved difficult to move. That was the theme of a paper read by H. D. Bowker, preparation engineer for the company. Complaints that 5/16x0 lacked the "flashiness" expected of Omar Island Creek coals and that fusion temperature of the ash was too low provoked a thorough laboratory investigation which pointed to the solution.

It was discovered that the minus-20 component had an ash-fusion temperature 350 deg. lower than the 5/16x0 and its removal increased the fusion of the remainder by 100 deg. Volatile matter in the minus-20 was unreasonably low and that led to a determination that the fusain content in the minus-20 was as high as 40 per cent and reached 65 per cent in the 200-mesh portions. These tests disclosed that the 20-meshx0 could properly be termed refuse; therefore any thoughts of cleaning that size were abandoned. With removal of the 20-mesh, the 5/16-in. coal no longer brought complaints and the former marketing difficulties disappeared. In addition to higher fusion temperature, lower ash and increased flashiness, there came the advantages of improved combustion efficiency, "eye appeal" to the customer, absence of dust, and less oil required when the coal is treated.

Removal of minus-20-mesh from 5/16x0 is done on a 4x8-ft. Tyler "400" electric screen with a feed of 24 t.p.h. equals 0.75 ton per hour per square foot of surface. By a series of changes, blinding difficulties first encountered have been eliminated, even though the moisture content of the fine coal may reach 10 per cent. Screen pitch is now 35 deg.; square mesh was replaced by elongated rectangular mesh; tension was placed on the larger longitudinal wires instead of on the smaller transverse wires; transversely tensioned ½-in. mesh backing cloth was added to whip the screen, and finally stainless-steel cloth was adopted to eliminate rusting, which was one cause of blinding.

The cloth now in use is "Toncap" with openings 0.035x½ in. Longitudinal wires are 0.028 in. in diameter and the transverse wires 0.035 in. Vibration of the screen was increased by replacing the 15-cycle a.c. current with 60-cycle in combination with a thermionic tube. The minus-20 material at this mine constitutes about 3 per cent.

M. H. Forester, manager, West Virginia division, Consolidation Coal Co., produced data collected during the last ten years on 20-mesh coals from hand-loading operations indicating that the No. 4 mine is a very special case and that generally the quality of the 20-mesh is such that the industry cannot afford to consider throwing it away. In northern West Virginia a test indicated it would reduce the mine output by 5.47 per cent, while in other sections the reduction would be from 3 to 16 per cent.

Introducing new loading methods, Mr. Forester cautioned, may bring a lower realization, thus canceling the apparent savings. The narrower the size range in domestic stoker coal, the happier the customer. He foresaw the use of a ¾- to ½-in. top size with the fines taken out for the type of domestic stoker which will be developed for the customer of low income. Replying to a question by J. R. Cameron, Mr. Forester agreed that

Sales of Mechanical Stokers Increase Sharply

Sales of mechanical stokers in the United States during September last totaled 20,398 units, according to statistics furnished the U. S. Bureau of the Census by 101 manufacturers (Class 1, 64; Class 2, 43; Class 3, 44; Class 4, 40; Class 5, 18). This compares with sales of 15,058 units in the preceding month and 20,452 in September, 1938. Sales by classes in September last were: residential (under 61 lb. of coal per hour), 18,105 (bituminous, 16,095; anthracite, 2,010); small apartment-house and small commercial heating jobs (61 to 100 lb. per hour), 1,093; apartment-house and general small commercial heating jobs (101 to 300 lb. per hour), 761; large commercial and small high-pressure steam plants (301 to 1,200 lb. per hour), 334; high-pressure steam plants (more than 1,200 lb. per hour), 105.

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Osmose "Natural Pressure" Treatment secures deep and effective penetration of proved wood preservatives without the use of any heating or pressure treating equipment. Treatment is as simple as whitewashing. Applicable to any wood species available in vicinity of your mine. No seasoning before treatment. WRITE FOR LITERATURE, IMPARTIAL TESTING LABORATORY REPORTS, COST DATA, etc.

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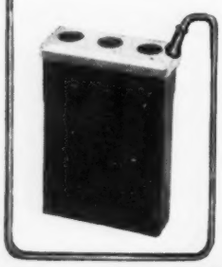

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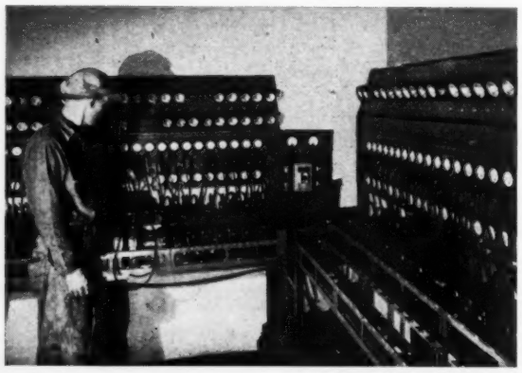

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Shipments of Anthracite To Canada Soar

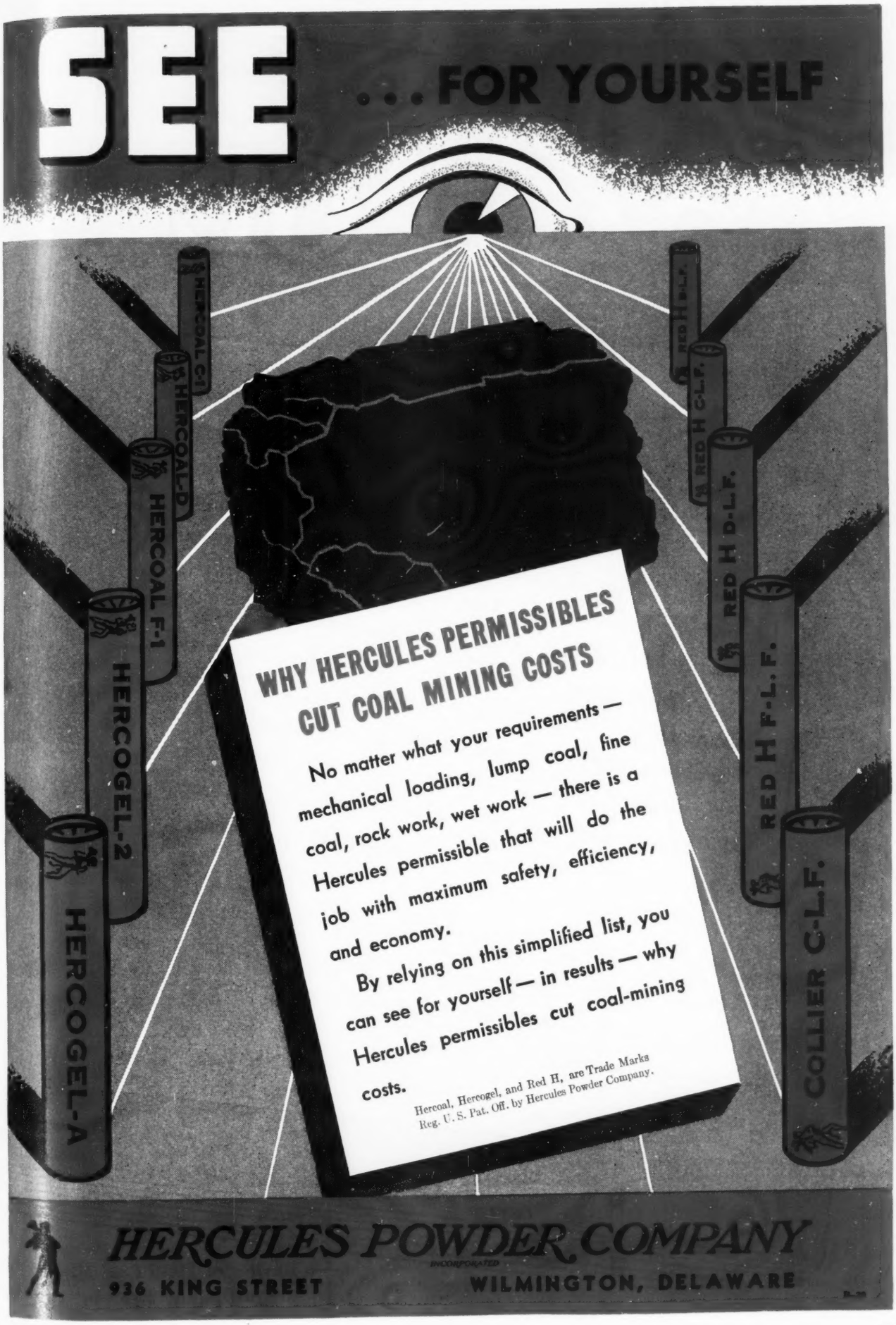
"Canada imported the greatest tonnage of Pennsylvania anthracite in September last that she has taken in any month for ten years," states Louis C. Madeira 3d, executive director, Anthracite Institute. "Imports from the United States in that month amounted to 361,917 net tons, or two and a half times the volume in September of last year," he said after reviewing a report of the Dominion Bureau of Statistics, Ottawa.

Continuing, Mr. Madeira pointed out that shipments of 1,952,351 tons for the first nine months of the year were 31 per cent ahead of the 1938 figure of 1,492,275 tons. Discussing production of the industry as a whole, he said: "Output for the year through Nov. 5 totals 40,622,832 tons, which is 4,985,153 tons better than we did in the corresponding period of last year, or about 14 per cent."

perhaps the slag-type furnace may affect the question of low-fusion fines. The Norfolk & Western, stated W. E. E. Koepler, secretary, Pocahontas Operators' Association, is now providing cars to haul fine coal and the Pocahontas mines, are seeking out markets for this product. Because many power plants are now being built which will not handle smaller than 1-in. or ¾-in. from railroad car to boilers, Joseph Pursglove, Jr., general manager, Pursglove Coal Mining Co., suggested that the coal industry get a finger into the design of such plants, so that conveying and chute equipment will be provided for handling fines such as 20-mesh, since to change a plant later would likely mean many thousands of dollars.

In a separate paper looking into the factors which may influence the increase or may level off "at, say, 20 or 30 per cent of the total" the growth in proportions of mechanically cleaned coal going to the commercial and railroad fuel markets, Mr. Pursglove dwelt on the advantages of washed coals for small stoker operation. Laboratories of large customers using both oil and coal, he stated, constantly call attention to the "better-than-guaranteed analysis of fuel oil received as compared to the wide variation in coal analyses." Increased construction of cleaning plants in recent years "as a basic part of complete mechanization programs", were characterized by Mr. Pursglove as "the healthiest sign in the entire industry because it is the only logical approach to the problem of combating oil, gas and waterpower competition—by producing the best product that modern coal-cleaning science will permit at the lowest possible cost to the consumer that modern mechanical coal-loading devices will permit."

Use of mechanical loaders, declared Leonard Sargeant, Fairmont Machinery Co., in a discussion read by J. M. Knowles, assistant purchasing agent, Consolidation Coal Co., compels the employment of mechanical cleaning. "That mechanical loaders pay," he added, "is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no longer debatable." Mechanical cleaning is a natural development of the industry and "it cannot and will not be denied." He suggested that the typical letterhead, "Miners and Shippers of Bituminous Coal," be changed to read, "Miners and Manufacturers of High-Grade Bituminous Fuels."

Five miles of thermit-welded track, never a broken thermit weld and two miles of main haulage road to be thermit-welded, is the status at mines of the Hanna Coal Co., according to C. C. Hagenbuch, of that company. Total all-inclusive average cost per joint for 300 joints on 80-lb. track was $6.76. Supplies cost $3.73 and labor $3.03. The cost included all minor items such as gasoline, oil, fireclay, files, goggles and wire brushes. A major item was smoothing the joint by cutting with a chisel while still hot, then grinding the top and one side to form smooth surfaces. On this job three lengths of rail were welded together on the outside, forming a single rail approximately 100 ft. long, and these 100-ft. lengths were taken inside and welded in place on the roadbed. If all welding had been done on the inside, the cost would have been somewhat higher because of the higher inside wage rate.

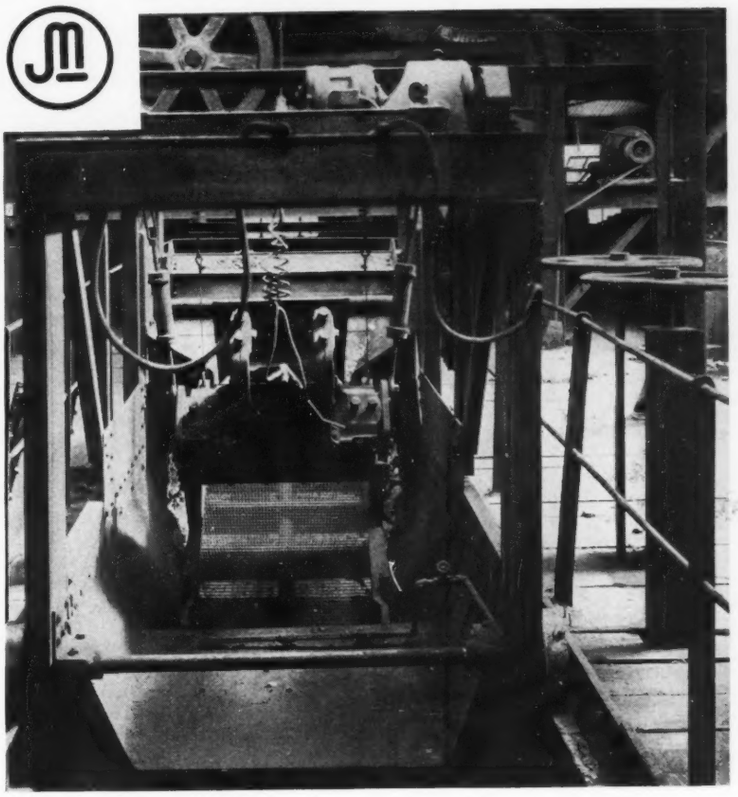
Welding Cuts Cost

On the 80-lb. rail the increased cost of a thermit-welded joint over an angle-barred and bolted joint is $2.24. Stated briefly, the savings are: (1) decreased rolling stock wear, (2) increased track life due to decreased rail wear at joints, (3) savings in road cleaning, (4) fewer derailments, (5) lower track maintenance cost, (6) power savings, (7) increased speed limit for main-line haulage. A study of total main-line track maintenance on a ton-mile basis at four mines of the company over a period of one year during which the total production was 3,500,000 tons indicates tangible savings with welded track. Cost in Mine A with no welded track is taken as the base, or 100 per cent. In Mine B, with 16 per cent welded track, the cost was 97 per cent; Mine C, 26 per cent welded, 80 per cent; and Mine D, 48 per cent welded, 36 per cent.

A recent practice of the company when installing 60-lb. track is to purchase the rails in 60-ft. lengths—costing a premium, of course, but thereby reducing by half the number of thermit-welded joints. Comparative track joint costs per 1,000 ft. of 60-lb. track follow: angle-barred and bolted, $204; thermit welds, 60-ft. rails, $287; thermit welds, 33-ft. rails, $348.

Selection of thermit welding was the result of an investigation by fracture tests. The first series was by continuous pressure on the rail as a beam of 12-in. span and was made on three types of electric arc weld, one type of manganese bronze weld, one acetylene weld and one center-poured thermit. The electric-arc butt-welded joint and the center-poured thermit showed strengths superior to other types. As a final test a rolling wheel load of 20 tons with 12-in. stroke was applied to welds centrally situated in 30-in. rail spans and the final destruction came at 366,000 cycles for the thermit weld and 196,000 for the arc weld.

As part of a discussion of the Hagen-



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buch paper, Prof. G. P. Boomsliter, West Virginia University, showed slides of rail welds tested to destruction in the college laboratory. Following the making of a few tests for the Pursglove Mining Co., Professor Boomsliter continued the investigation and to date has tested about 40 arc- and gas-weld rail joints. With the arc-weld specimens, 70 to 80 per cent of rail strength has been secured; the highest figure was with a specimen without any weld in the web. Otherwise it was the typical Pursglove weld with a plate on the bottom and done without V'ing the rail (see pp. 77 and 93 of this issue.)

Preliminary tests resulting in some breaks entirely outside of the weld demonstrated that new rail only, rather than rusted or used rail, should be used in making the investigation. It is estimated that the coal industry of the State would save $1,000,000 per year in track maintenance with welded rails. By further tests on specimens furnished by coal companies and on welds made in the laboratory, Professor Boomsliter is now seeking the answer to the question, "How cheap can we make welds and make them good?"

Welded Track Holds

Mr. Pursglove reported that on the 18,000 ft. of welded track in the Pursglove mines no failures have occurred to date, excepting that four joints broke the first night. Indications are that those four welds were someone's experimental job with a resistance welder instead of the work of the experienced man using the motor-generator welder. One man was able to arc-weld six joints easily in 7 hours. Joints were not ground but were peened while hot to a semblance of smoothness. Service has made them quite smooth.

Continuing the discussion, W. F. Lautner, Air Reduction Sales Co., presented the following cost figures on preparation and welding of 60-lb. rail joints: bronze oxyacetylene, $1.07 to $1.25; steel oxyacetylene, $2.78 to $3.33; and steel metallic arc, $2.33 to $2.88. In static tests to destruction, Mr. Lautner reported the welded rails stood 75 tons, 100 tons and 100 tons respectively. The cost for the steel metallic arc weld included preheating to 1,000 deg., peening the weld and reheating and cooling slowly to normalize. He thought the bronze oxyacetylene weld most satisfactory from all considerations, one of which is less skill required of the operator.

"A good rule of thumb is to not permit any operations more than 3,500 ft. from the source of supply," advocated R. E. David, power engineer, Appalachian Power Co., Welch, W. Va., in a paper on, "Distribution of Power for the Mechanical Mining of Coal." He presented drawings describing the case histories of two mines in which substations were moved closer to the workings to tune up power for introduction of loaders.

"The station should be located," said Mr. David, "on one of the mains, underground, so that it will be on the main feeder or trolley and will also be on the air. There may be cases where it is undesirable to locate a station underground, but where a station is located outside, sometimes several hundred feet of feeder is required to reach the desired point. This is added resistance and may

shorten the distance that can be worked from this location. Sometimes, with drift mines, the station can be located outside and only a short distance from the desired point of distribution. Even with shaft or slope mines this occasionally happens. With a condition of this kind, cheaper installation costs can be expected, but with manually operated stations, power outage due to failure from the a.c. supply usually will be longer and inspections may be somewhat neglected.

"Should the station be located underground," he continued, "it may be supplied by overhead line to a borehole or drift mouth, or by cable underground. The overhead line usually is preferable and cheaper except in case of a deep borehole. Sometimes with shaft mines a borehole near the desired location is out of the question due to mountains. When cable is used, an oil circuit breaker with overload and phase-failure protection should be installed where the cable enters the mine."

In the interest of safety, said Mr. David, on original installations serious consideration should be given to adding a bare wire of ample size to the cable for grounding inside. It is impossible to get safe or adequate grounds inside the mine. Under no condition should high-voltage equipment be grounded to the rail or negative feeder. "It is very dangerous." Continuing his precautions about grounds, Mr. David said: "Do not connect lightning-arrester grounds to the rail or neutral. This refers particularly to some locations where a station is located inside the mine with the supply cable entering directly by a borehole and capacitor arresters are installed. With arresters or other high-voltage equipment grounded to the rail, ground currents may be set up under certain conditions which are very dangerous. A separate ground should be provided."

—⟡—

New Preparation Facilities

BIG BEND COAL MINING CO., Twin Rocks, Pa.: Contract closed with Roberts & Schaefer Co. for complete Stump "Air-Flow" cleaning plant; capacity, 65 tons per hour of ¼x0-in. coal; to be completed Feb. 1, 1940.

KOPPERS COAL CO., Kopperston mine, Kopperston, W. Va.: Contract closed with Koppers Rheolaveur Co. for first unit of a coal-washing plant; capacity, 175 tons per hour; to be completed in about four months.

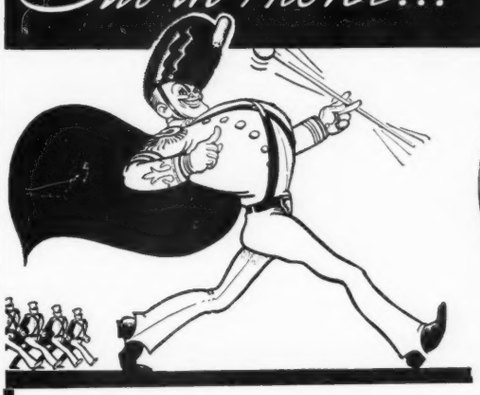
MORRIS RUN COAL MINING CO., Morris Run, Pa.: Contract closed with Wilmot Engineering Co. for hydro separator for cleaning ⅜x2-in. coal at rate of 30 tons per hour; this is addition to existing facilities.

—⟡—

Angle Mine Again in Action

Preparations to reopen the Angle mine of the Pocahontas Fuel Co. were under way on Nov. 4, according to announcement by company officials. The operation, which is at Maybeury, W. Va., has been closed for several years. R. L. Hutcheson is superintendent of the mine.

Out in Front...



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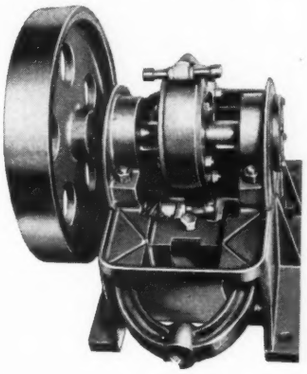

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Regulation, Safety and Mining Debated At 15th District Institute Meeting

WITH speakers canvassing subjects from federal regulation to education in safety promotion, the 27th Mining Institute of the 15th Bituminous District of Pennsylvania was host to some 200 mining men at the St. Thomas Parish House, Barnesboro, Pa., Nov. 4. Mechanical loaders vs. conveyors found a program spot, along with cutter bits, roof control and better lighting.

A dinner at St. Edward's Catholic Church followed the technical program with Dennis Keenan, 15th district mine inspector and president of the institute, officiating. Mr. Keenan also presided at the meeting. During dinner, James Logan, instructor, Pennsylvania State College Extension Department, stressed safety in coal mining. Haste and pressure to make up lost time were blamed for carelessness and violation of the mining laws by Mr. Logan, with consequent increase in injuries. Furthermore, he stated, responsibility does not fall entirely on the miner, as careless inspection, faulty supervision and too much work for supervisors take their toll.

The entire institute committee was returned to office and two new members were added. Mr. Keenan thereby was reelected president; J. G. Nicholson, superintendent, No. 17 mine, Pennsylvania Coal & Coke Corporation, treasurer; and C. P. Brinton, chief engineer, Barnes & Tucker Co., Barnesboro, secretary. New committee members are D. J. Sullivan and Henry Barraclough. The institute also paid its respects to W. B. Wardrope, first president, about eighteen years ago, and now mine inspector at Indiana, Pa.; Thomas Lowther, now retired from the inspection force; and Mr. Nicholson, another charter member. Members were welcomed to Barnesboro by Burgess D. A. Westover.

Pointing out that bituminous coal still is the primary source of energy, although it has been losing ground in late years, B. W. Derringer, Altoona, Pa., Central Pennsylvania Producers' Board, reviewed the history of coal regulation and its underlying causes, including the war and post-war booms with their enormous increase in production capacity and the 1929 collapse, following which the industry reached its "lowest point in history."

Under the present Bituminous Coal Conservation Act of 1937, passed to salvage the good features of the act of 1935 and eliminate provisions of doubtful constitutionality, new price schedules are being carefully and conscientiously prepared to meet court attacks. In view of the protracted hearings, said Mr. Derringer, it probably will be 1940 before they go into effect. Even then, smooth sailing cannot be expected, as a number of coal companies and other interests are preparing court attacks. But, he declared, all agree that if bituminous coal is to be regulated, the government should cease building hydro-electric projects and competitive fuels should be regulated.

Mechanization in some form is a necessity in central Pennsylvania if producers are to stay in business and meet competition not only from other firms in the field but from other regions and substitutes, declared T. F. McCarthy, general superintendent, Clearfield Bituminous Coal Corporation, Indiana, Pa. And mechanization need not mean deterioration in coal quality, as, in fact, some producers are shipping an even better product than before. Factors in the choice of mechanization equipment are many and cover investment cost, including new preparation plants, haulage equipment, etc.; leaving pillars with consequent waste of coal; safety, etc.

Dennis Keenan
On the presidential dais

Mobile loaders as yet have not been used entensively in thin seams, although much experimentation is under way. Roof conditions and seam thickness, particularly where crossbars are required, will, in Mr. McCarthy's opinion, be the limiting factors in mobile loaders in thin coal. And where loaders are used in coal under, say, 4 ft., conveyors or shuttle cars normally will be required for transportation. While not yet used in numbers, the short-wall-type loader working on the mine bottom should play a greater part in thin-seam regions, said Mr. McCarthy. Shaking conveyors with self-loading heads, which have given good results in other regions where seam and roof permit, also should advance. All types of hand-loaded conveyors, with the exception of the so-called mobile conveyors, may be grouped in one class, and proof of their advantages is afforded by their increasing use in central Pennsylvania. And if no substantial revisions are made in self-loading equipment to decrease production cost markedly when used in thin seams, the increase will continue. And if self-loading equipment is improved, conveyors still will be required in many cases for transportation.

If he were to prophesy, said Mr. McCarthy he would forecast tremendous changes in methods and machinery, including equipment capable of 3,000 to 5,000 tons in 24 hours in "these thin seams." Careful attention should be devoted to eliminating as much of the prevailing inefficiency as possible, as mining companies must be in position to meet price competition because there is no assurance that fixed prices will continue. Therefore, operating men must get costs down so that their companies can hold present business and regain losses.

Early coal cutting was marked by much attention to the machine proper but very little to the cutting agent itself—i.e., the bit—declared John Buch, department of mining engineering, Pennsylvania State College, State College, Pa. Paying tribute to C. L. Bowman, of the Bowdil Co., Professor Buch pointed out that research has established certain principles. Better bits, he averred, are a direct economy in reducing power. Indirect benefits flow from less maintenance on machine and chain, lower bit cost, and higher cutting speed. Finally, improved cutting betters bug-dust quality.

Research in bit design has evolved the so-called two-point throw-away type. As evidence of what this new bit can accom-

John Buch
Attends the cutter bit

George C. Hood
"Support no short order"

T. F. McCarthy
Ventures a prophecy

V. A. Stanton
Better light his theme

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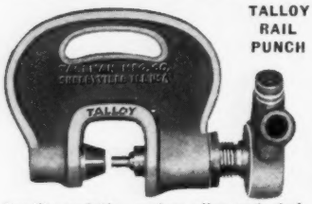

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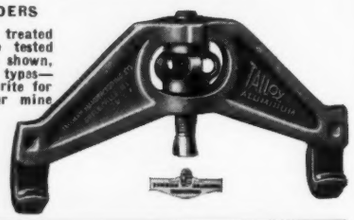

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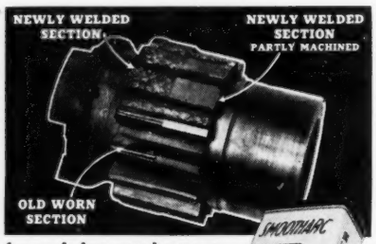

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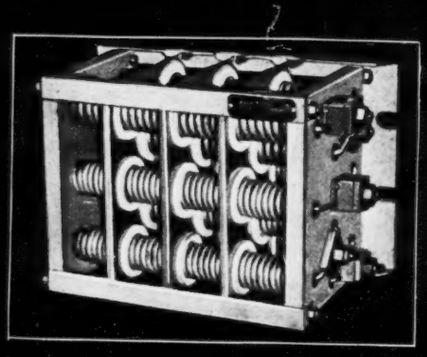

FOR MINING MACHINES MINE LOCOMOTIVES

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GUYAN MACHINERY COMPANY

LOGAN, WEST VIRGINIA

Table I—Summary of Results of a Test of Conventional and Factory-Made Multiple-Pointed, or Throw-away, Cutting Bits at a Harlan County (Kentucky) Mine

	Conventional Bits	Throwaway Bits
Number places cut	5	8
Area cut, sq. ft.	636	882
Tons cut	110	173
Cutting time, minutes	83	97
Bit-setting time, minutes	31	9
Number bits used	62	18
Power used, kw.hr	29.17	25.16
Per sq.ft.	0.046	0.029
Per ton	0.265	0.140

COMPARISON OF RESULTS

	Conventional Bits	Throw-away Bits	Economy per Ton
Cost of bits, per ton	$0.00700	$0.00233	$0.00467
Maintenance cost, per ton	0.02500	0.00934	0.01566
Power (2 c. per kw.-hr.)	0.00530	0.00290	0.00240
Cost of time, per ton	0.02591	0.01531	0.01060
Cost of depreciation	0.01250	0.00800	0.00450
Total economy, per ton			$0.03783

plish, Professor Buch stated that a test in Harlan County, Kentucky, showed an advantage of 3.783c. per ton, taking into account bit cost, power, labor, maintenance and depreciation. Details are given in Table I.

Bit-gage accuracy substantially influences power demand, and with the throw-away type a more even gage is assured and each bit comes closer to taking its own share of the cutting. Pick points also characterize throw-away bits. Such points have definite advantages over the original chisel point. And most conventional bits are used without definite control of tempering, largely because the volume does not warrant the expense. Thus, bits are of a variety of cutting efficiencies, with the poorest setting the pace. With throw-away bits, volume factory production promotes accurate heat-treatment. On the whole, therefore, throw-away bits seem to have a number of advantages, including: (1) Most suitable material, (2) accurate factory heat-treating, (3) automatic gaging, (4) proper cutting angle, (5) uniform clearance, (6) uniform cutting edge and (7) one less problem for the operating man.

Cost of the throw-away bit is about 3c. each, or 1½c. per point. Conventional bit cost is ¾ to 1½c. per point, but the throw-away bit will give three to seven times the service with the same power, time, can be used duller without appreciable increase in power consumption. Lately hard-surfacing of conventional bit points has been widely practiced, but one problem is applying the material without damaging the stock. Reported costs of such tipping, said Professor Buch, run as low as 0.8c. per point, but the average probably is around 2c.

Recent years have witnessed elaborate tests on bit positions and chain lacings. With a soft and grain-loose coal, chain design results in little difference in performance. In a hard, free-cutting, snappy coal, a five-position lacing and fast feed tend to give coarse cuttings. In a woody coal, a close position is best. Where sulphur balls, rock, etc., are encountered, the system must be judged largely by local conditions. On bit lead, Professor Buch observed that where it is desired to hold the machine in the kerf, as in longwall mining, a 22-deg. lead is preferable. A 13-deg. lead is preferable with shortwall or arewall machines, except in

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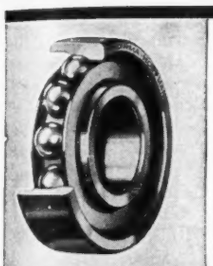
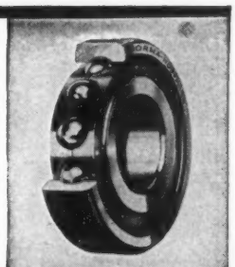
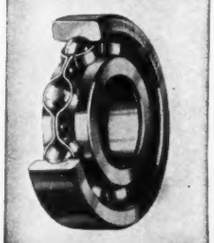


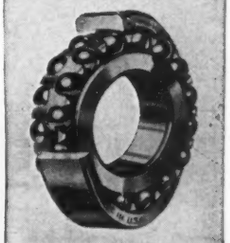
Separable (Magneto) Ball Bearing



Litro ("CL") Composition Retainer Ball Bearing

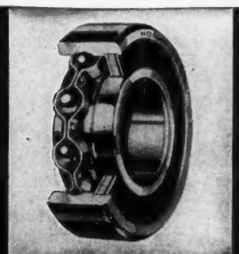


Single Row Ball Bearing

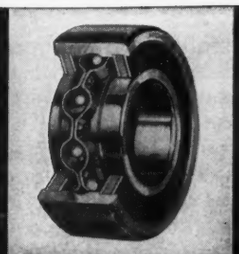


Double Row Self-Aligning Ball Bearing

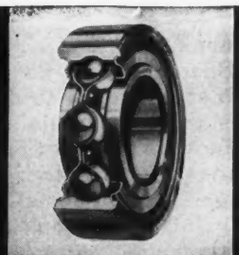
Shielded Type Single Row Ball Bearing



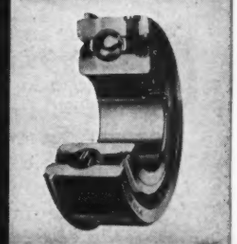
Single Felt Seal Ball Bearing



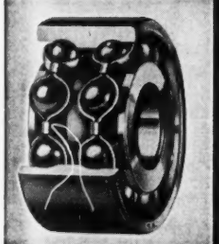
Double Felt Seal Ball Bearing



9000 Series (Feltless) Sealed Ball Bearing

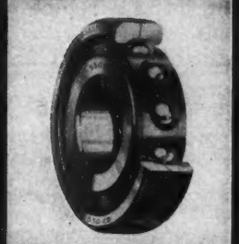


"Cartridge" Fully Sealed Refillable Type Ball Bearing

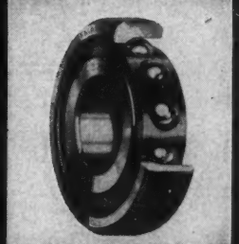


Double Row Ball Bearing

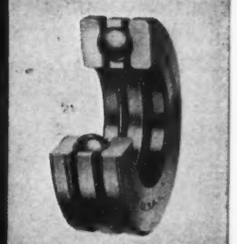
Extra Light Type Ball Bearing



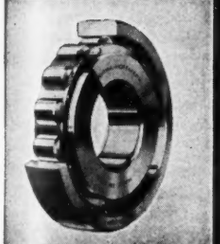
Duplex Type (Two Direction) Angular Contact Ball Bearing



Angular Contact Ball Bearing

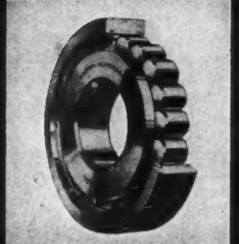


Single Direction Ball Thrust Bearing



Standard Cylindrical Roller Bearing

Double Row Self-Aligning Adapter Ball Bearing



Full Type (Retainerless) Cylindrical Roller Bearing

Extra Light Cylindrical Roller Bearing

Two-Lipped Cylindrical Roller Bearing

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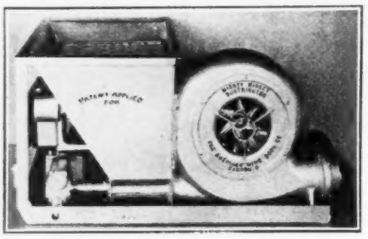

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very hard cutting, where 7 deg. usually is best.

Bit-position and lacing systems include the eleven-position six- and seven-way type frequently employed by manufacturers and mine mechanics. However, a nine-position straight-wedge system with the center bit leading will cut power consumption about 20 per cent as a rule. Where hard cutting is encountered in the top or bottom of the kerf, systems include seven-position cutting both top and bottom with extra bits in the bottom (or top) and seven-position cutting the softer section, with nine-position for the harder. A nine-position wave-lacing system with the bottom bit leading will hold a machine down better. In longwall or long-face work, where the direction of travel is reversed, the objective should be for the same power demand both ways. A reverse-wedge system often is used, but, said Professor Buch, a combination of staggered and reverse-wedge is better. Core breakers are a benefit where bands of hard coal or impurities are encountered and also aid in moving bugdust out of the kerf.

Among improvements is an alloy-steel bar heat-treated for rigidity and making a somewhat thinner (about 4-in.) kerf. The new bar also is cored. Thus, it is possible to drill the bar and put in taps to wet the cuttings.

Education Essential

Declaring education absolutely essential in safety work, J. J. Forbes, supervising engineer, safety division, U. S. Bureau of Mines, Pittsburgh, Pa., stressed the importance in such education of first-aid training. Every mining company, therefore, should include it in its safety program, as experience has shown that a trained person is less likely to be injured. And by starting with first aid, employees are more disposed to cooperate in other safety measures. Further mine-rescue training also is a necessity to replace veterans and maintain the reserves of men capable of handling such work.

A new mine-rescue telephone, still in the development stage although it has seen actual service, was demonstrated by F. E. Griffith, associate mining engineer, Bureau of Mines, Pittsburgh, Pa. Assisted by Mr. Forbes, Mr. Griffith showed how this telephone replaces the old unreliable life line and provides quick and detailed two-way communication between the fresh-air base and apparatus men.

While roof control admittedly is difficult, some of the troubles vanish if the right approach is selected, said George C. Hood, safety inspector, Ebensburg Coal Co., Colver, Pa. The objective is a system of posts or other supports in the proper position at the face to keep the unsupported area to a minimum. Theory and experience, in the view of many mining men, support the conclusion that the greatest subsidence takes place during cutting, although others hold that it occurs during shot-firing.

A hard problem is the variation in roof in various seams or in different sections in the same seam. At the same time, adequate support cannot be stressed too strongly. The hazards in roof control reflect directly the extent to which the beds overlying the coal are broken in mining. If, during mining, the bed immediately over the coal can be kept unbroken and only slightly separated

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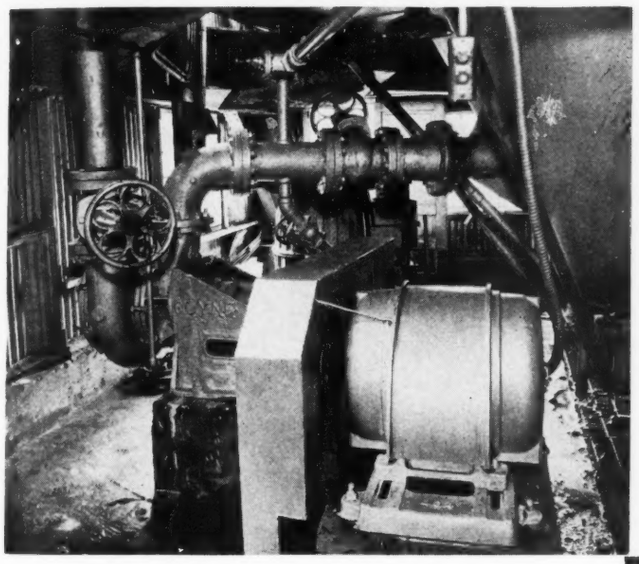


Below: Showing one of three Goyne drainage pumps installed in 1927 at the Federal No. 1 Mine of the Koppers Coal Company at Grant Town, West Virginia. These pumps have built up an enviable record in their twelve years of operation at this mine.

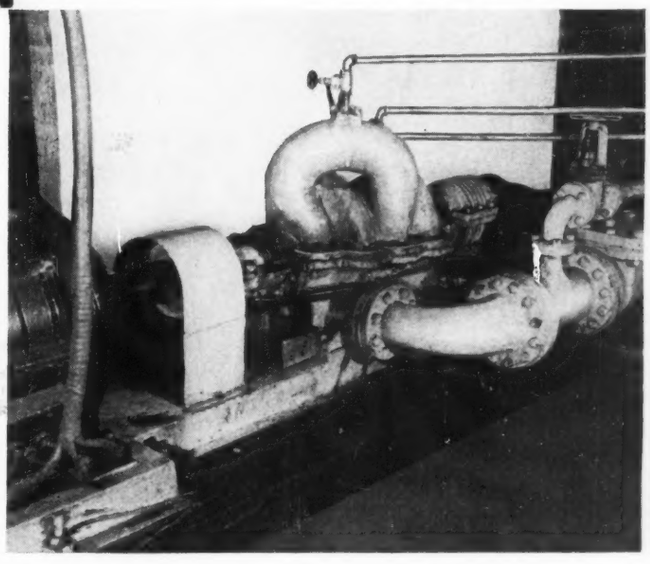
If your pumping costs are high, due to power or repair parts, we can offer you a pump built especially for your service and water conditions. We have served the mining companies exclusively for almost 60 years.

Pump catalogs and information on accessories and automatic pump control furnished on request.

Above: Illustrating one of two Goyne washery pump installations made for the Pursglove Coal Mining Company at Pursglove in West Virginia. These pumps serve Chance Cones of the Chance Sand Flotation System.

Customer choice of these pumps was based upon accessibility of parts. The impeller, casing ring and shaft sleeve may be removed and replaced in one-half hour or less. Variable speed "V" belt drive is used permitting capacity changes without throttling. Exceptionally good life and absence of excessive labor costs for repairing places this equipment in the low cost column.

Write for Bulletin 1609 if you are interested in cutting costs on washery pumps for any type of coal cleaning systems.



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from the overlying measures, it will form a protective covering.

"Systematic timbering is the only practical method we can apply to roof control," declared Mr. Hood. The method will vary with conditions but the crux is adequate support at the lowest cost. In other words, timbering should keep the place safe and also open as long as needed. And timbering should not be expected to support all the overburden to the surface but rather should protect men and equipment, help hold the strata immediately over the coal, equalize the load on the various supporting elements and give a warning.

Systematic timbering naturally requires both a study of the roof and of the circumstances surrounding accidents from falls. It is most essential, however, that all foremen strictly follow the plan, at the same time keeping an eye out for changes in conditions. And systematic timbering does not excuse workmen from due care. In headings, in particular, too much reliance often is placed on the apparent strength of the top. While systematic timbering may be difficult in such places it is about the only way of insuring protection. On machine-cut faces, the importance of support immediately after the machine passes has not been realized sufficiently, with the result that much difficulty has been encountered. Until recently, support largely was a matter of local judgment. Now, however, research is throwing light on fundamentals and bad practices. A continuing stumbling block, however, is lack of knowledge as to the thickness and character of overlying measures.

Conclusions on roof support were offered by Mr. Hood as follows:

1. The object of roof support is to allow the beds to bend slightly and free themselves from the upper measures, thus preventing breakage.

2. Lowering and separation of the roof beds is permitted by the yielding of the posts and bars. If too few, the load may be too great and the roof may be broken.

3. A post improperly set may result in uneven loading. Cap pieces increase the bearing and facilitate setting, in addition to protecting the prop against splitting or breakage from roof irregularities and settlement. The use of caps is an important factor in timbering.

4. The character of the roof and floor and the pitch of the coal varies between seams and localities and necessitates variations in the prescribed methods of timbering. Local conditions, therefore, must be studied carefully.

5. Patience and perseverance are vital in securing best results.

"Better Light, Better Sight," a motion picture dealing with electric cap lamps for underground lighting sponsored by the Mine Safety Appliances Co., was the concluding feature of the technical session. Introducing the picture, V. A. Stanton, M-S-A representative, Johnstown, Pa., demonstrated the improved light-giving qualities of the latest cap lamp.

Rush N. Hosler

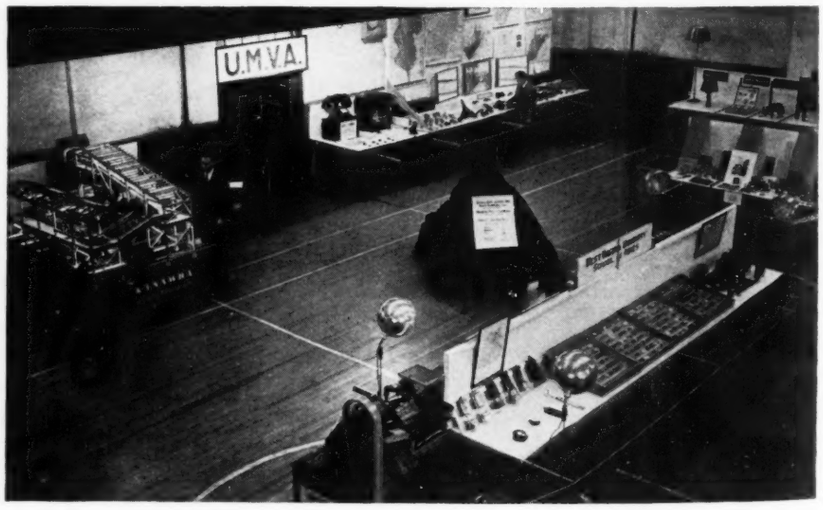
Obituary

HARRY A. SMITH, 61, president, Delaware, Lackawanna & Western Coal Co., New York City, died Nov. 10 at his home in Newark, N. J., after a brief illness. Born in Scranton, Pa., he joined the coal-mining department of the D.L.&W. in 1897, devoting the rest of his business career to the anthracite industry and succeeding Eliot Farley as president on May 5, 1937. During fuel shortages in 1917-18 and 1922 he served as chairman of a New York committee organized to insure coal to small dealers. He helped organize and was for many years chairman of the sales executive committee of Anthracite Industries, Inc., and was a director of the Anthracite Institute.

RUSH N. HOSLER, 65, director, Coal Mine Section, Pennsylvania Compensation Rating and Inspection Bureau, Harrisburg, Pa., died Nov. 5 from a heart affection. An authority on coal-mine-accident compensation, he also was a past president of the Coal Mining Institute of America, a member of the Mine Inspectors' Institute of America and of the Coal Section, American Institute of Mining and Metallurgical Engineers.

JOHN DANIEL PRICE, 53, general manager, Montreal Coke & Mfg. Co., Montreal, Canada, died suddenly Nov. 10 of a heart attack at his home there. Since his graduation from the Case School of Applied Science he had devoted his entire career to the development and operation of byproduct coke plants. He was operating engineer with the Koppers Co. in Pittsburgh, Pa., before going to Canada in 1927 to supervise construction of the Montreal Coke & Mfg. Co. plant at Ville Lasalle, of which he became superintendent, being appointed general manager a few years ago.

FRANK A. FINNEGAN, 48, a member of the classification and price committee



Northern West Virginia Show Features Coal Byproducts

Derivatives of coal which ranged from nylon stockings for milady to poker chips and false teeth featured a comprehensive industrial display at the tenth annual Mountain State Forest Festival, at Elkins, W. Va., in October. Sponsored by the Upper Monongahela Valley Association, a promotional agency, the display had more tlan 30 major national exhibitors including plastics manufacturers, byproducts plants and mining-equipment makers. A section of the display hall is shown above.

of District 8 Bituminous Coal Producers' Board, died Nov. 7 of a heart attack at his home in Fort Mitchell, Ky. For many years he had been assistant to the late John Dewberry, coal traffic manager of the Louisville & Nashville Ry.

THEODORE S. BARBER, 67, president and general manager of the Morris Run Coal Mining Co., Morris Run, Pa., died Oct. 25 at his home in Wilkes-Barre, Pa. He had been identified with the anthracite industry for forty years, being a director of the Lehigh Valley Coal Co. and Burns Brothers, as well as president of Ellsworth & Co.

ROBERT L. STEARNS, 67, chairman of the board of the Stearns Coal & Lumber Co., Stearns, Ky., died Nov. 2 in Tucson, Ariz., whence he had moved three years ago when he began to suffer from asthma. He had been president of the company for 37 years, having recently been succeeded in that post by John E. Butler (*Coal Age*, October, p. 76).

JOSEPH N. SCHWEITZER, 72, superintendent at the Lundale mine of the Logan County Coal Corporation, Lundale, W. Va., died Oct. 28 at Logan of a heart attack. A native of Pennsylvania, he had been with the company since 1912.

JOHN M. DEWBERRY, SR., 66, general coal and coke manager for the Louisville & Nashville Ry. since 1921, died Oct. 26 at the St. Joseph Infirmary, Louisville, Ky., after a long illness. He had been in the railroad industry for 52 years.

PELHAM HANSARD ANDERSON, 49, president of the Grider Coal Sales Agency, Birmingham, Ala., died Nov. 6 of a heart attack.

FRANK D. VAN WINKLE, 71, president of the Post-Glover Electric Co., Cincinnati, Ohio, died Nov. 1 of a heart attack. He helped organize the company in 1892, becoming secretary in 1893.

PAUL LANIER, 47, Southern sales manager for Walter Bledsoe & Co., died Nov. 6 in Knoxville, Tenn. Previous to his connection with the Bledsoe company he had served as sales manager for the Moss & McCormack Co. and subsequently in the same capacity for the Diamond Coal Mining Co., both of Birmingham, Ala.

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Personal Notes

PEARL BASSHAM, hitherto vice-president in charge of operations and general manager of the Harlan-Wallins Coal Corporation, Verda, Ky., has been made president. The company has 1,700 employees and six mines, of which four are in operation with a daily capacity of 7,500 tons.

P. G. CARROLL has been appointed superintendent at the Hitchman mine of the Hitchman Coal & Coke Co., Benwood, W. Va.

D. H. DAVIS has been appointed production scheduler by the Pittsburgh Coal Co., Pittsburgh, Pa., vice J. E. Norton, transferred.

JOHN K. DENT has been appointed general coal freight agent by the Louisville

Your Employees Too Welcome "Lower Costs"

Many leading West Virginia coal operators have for years made available to their Employees the Provident Group Welfare program which, by reason of premium payments over the payrolls, brings protection to Employees at low wholesale costs.

Provident the leader in states shown

To this wide-spread patronage of coal mine operators and their employees the Provident owes in large measure the place of leadership accorded it again in 1938 as the producer of the largest volume of Accident and Health business in West Virginia, a place of leadership likewise achieved in seven additional adjacent states, here shown.

If your Employees are not now enjoying the protection available through Provident Group Welfare plans, would it not be worth your while to investigate the possibilities they offer? There is no obligation, of course.

PROVIDENT

Group Welfare protection plans "made to measure" for your own mine, without cost to you, can help solve emergency problems of Employees caused by

- **Death in Family**
- **Loss of time due to accident or sickness**
- **Aiding dependents upon death of employee**

Provident Life and Accident Insurance Company

Chattanooga *Since 1887* **Tennessee**

The Pioneer Insurance Company writing Group Welfare Plans with Premiums Paid over Coal Mine Payrolls

RUBBER-CUSHIONED MOUNTINGS . . . .

COUNTER-BALANCED SHAFT . . . . . .

HEAVY-DUTY ROLLER BEARINGS

ON ALL *Simplicity* GYRATING COAL SCREENS

Resilient rubber mountings, counterbalanced eccentric shaft, and heavy-duty roller bearings are three of the many outstanding features that enable Simplicity gyrating screens to step-up the efficiency and lower the cost of your coal screening operations.

Simplicity single, double and triple-deck screens — for the past sixteen years — have proved their superiority in cleaning, grading and dewatering coal in mine tipples, unloading docks and coal yards. They are also proving exceptionally speedy in the processing of stoker coal and in the oiling and waxing treatment.

Each Simplicity unit is fully guaranteed. If not completely satisfactory it may be returned without obligation. Mail a postcard TODAY saying, "Please send facts about how Simplicity Gyrating Coal Screens can help us."

Making egg and chestnut coal at the rate of 25 tons per hour, feed, 2 x 3' double deck screen. This is one of the three Simplicity screens in this tipple.

Simplicity

ENGINEERING COMPANY

DURAND, MICHIGAN

& Nashville Ry., with headquarters at Louisville, Ky. He succeeds the late J. M. Dewberry.

J. M. Doss has been made assistant foreman by the Lorado Coal Mining Co., Lorado, W. Va.

John Gay has been named foreman by the Kelleys Creek Colliery Co., Ward, W. Va.

H. F. Hebley has been placed in charge of the product control department by the Pittsburgh Coal Co., Pittsburgh, Pa. As product control manager he will direct all matters pertaining to control of quality of product, production scheduling and research. He was formerly with the Allen & Garcia Co. and more recently with the Commercial Testing & Engineering Co.

H. R. Honaker has been appointed superintendent at Micco No. 3 mine of the West Virginia Coal & Coke Corporation, Micco, W. Va.

C. E. Hough has been named superintendent at Omar No. 4 mine of the West Virginia Coal & Coke Corporation, Omar, W. Va.

C. E. Jones has been made general night foreman at Micco No. 3 mine of the West Virginia Coal & Coke Corporation, Micco, W. Va.

Guy Lawrence has been appointed assistant foreman at Micco No. 3 mine of the West Virginia Coal & Coke Corporation, Micco, W. Va.

D. Lilly has been named foreman at the Kopperston mine of the Koppers Coal Co., Kopperston, W. Va.

W. Lowe has been made mine foreman at Micco No. 3 mine of the West Virginia Coal & Coke Corporation, Micco, W. Va.

Edward Mack, Jr., former head of the department of chemistry at the University of North Carolina, has been named to the supervisory staff of Battelle Memorial Institute, Columbus, Ohio. He will act as technical adviser in physical chemistry to sponsored industrial projects, and in addition will correlate the institute's fundamental research work. Dr. Mack is a graduate of Centre College and of Princeton, receiving his doctor's degree from the latter in 1916. He later studied at Harvard, the Sorbonne, the University of Chicago and the University of Munich. He has had varied experience as an industrial consultant, and was a member of the National Research Council, 1928-33, and of the Westinghouse Advisory Board, 1930-1.

J. E. Norton has been transferred to the industrial relations department of the Pittsburgh Coal Co., Pittsburgh, Pa., as assistant industrial relations manager.

D. Parsons has been appointed general night foreman by the Chafin-Jones-Heatherman Coal Co., Peach Creek, W. Va.

Lloyd J. Speed, theretofore general manager, was elected president of the Black Star Coal Co., operating in Harlan County, Kentucky, and the Pioneer Coal Co., in Bell County, at a meeting of directors on Oct. 30. He succeeds Frederick M. Sackett, who was elevated to chairman of the board. Mr. Sackett resigned the presidency, giving advancing age as the cause.

Permissible Plates Issued

Four approvals of permissible plates were issued by the U. S. Bureau of Mines in October, as follows:

Goodman Mfg. Co.: Type 75 Conway shovel; 75-hp. motor, 440 volts, a.c.; Approval 382-A; Oct. 11.

Mine Safety Appliances Co.: M.S.A. semi-portable rock-dusting machine; 2-hp. motor, 250 volts, d.c.; Approval 383; Oct. 11.

Goodman Mfg. Co.: Type G-15-B-82 shaker conveyor; 15-hp. motor, 440 volts, a.c.; Approval 384-A; Oct. 23.

Goodman Mfg. Co.: Type 154-AO4C storage-battery locomotive; Approval 1530; Oct. 14.

J. McG. Stewart, of Halifax, N. S., has been appointed Coal Administrator for the Dominion of Canada by the Wartime Prices and Trade Board under the chairmanship of Hector McKinnon. Mr. Stewart will have jurisdiction over maintaining and stimulating, in cooperation with the provinces concerned, the production of Canadian coal and other solid fuels and will supervise the purchase, shipment, distribution and allocation of coal, coke and other solid fuels, whether domestic or imported. He also will be responsible for assuring regular and adequate supplies of coal at reasonable prices in every region of the Dominion.

Oliver Weatherholt has been named assistant foreman at the Micco No. 3 mine of the West Virginia Coal & Coke Corporation, Micco, W. Va.

John L. G. Weysser, research engineer for the Lehigh Navigation Coal Co., Lansford, Pa., has become assistant professor of mining engineering at the University of Illinois, Urbana, Ill.

A. N. Worstell has been named district coal agent at Chicago by the Pennsylvania R.R.

Name New B.C.R. Directors

New Class A directors for Bituminous Coal Research, Inc., research organization supported by the industry and affiliated with the National Coal Association, were announced Nov. 14 by Charles C. Dickinson, president of N.C.A., as follows: J. E. Butler, president, Stearns Coal & Lumber Co., Stearns, Ky.; E. H. Davis, vice-president, New York Coal Co., Columbus, Ohio; H. A. Glover, assistant to president, Island Creek Coal Co., Huntington, W. Va.; L. W. Householder, vice-president, Rochester & Pittsburgh Coal Co., Indiana, Pa.; Ralph E. Jamison, vice-president, Jamison Coal & Coke Co., Greensburg, Pa.; S. S. Nicholls, president, White Oak Coal Co., New York City; D. H. Pape, president, Sheridan-Wyoming Coal Co., Monarch, Wyo.; R. H. Sherwood, president, Central Indiana Coal Co., Indianapolis, Ind.

Class B directors, elected at a recent stockholders' meeting in New York City but not heretofore announced, comprise the following: J. W. Carter, president, Carter Coal Co., New York City; Irvin

Davis, president, Hatfield-Campbell Creek Coal Co., Cincinnati, Ohio; H. N. Eavenson, president, Clover Splint Coal Co., Pittsburgh, Pa.; B. R. Gebhart, vice-president, Chicago, Wilmington & Franklin Coal Co., Chicago; John A. Howe, executive vice-president, Truax-Traer Coal Co., Chicago; J. B. Morrow, vice-president, Pittsburgh Coal Co., Pittsburgh, Pa.; Grant Stauffer, president, Hume-Sinclair Coal Mining Co., Kansas City, Mo.

This corporation, set up six years ago to promote and coordinate coal-research activities on a nation-wide scale, now has under way an enlarged program of cooperative activities in various channels, of which announcement is promised within a few weeks.

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One Dead, One Wounded In Mine Shooting

Robert Brown, construction superintendent, was killed and Brent Hart, president, Hart Coal Corporation, was shot in the left thigh in an attack on Nov. 8 by a band of men estimated at 250. The attack took place at a new mine of the company being prepared for operation, about 30 men being at work constructing a temporary tipple at the time. The mine is about two miles from White City, on the Muhlenberg-Hopkins County line, Kentucky. The company has four other mines in Hopkins County. Mines in Muhlenberg County work under contracts with the United Mine Workers, while most of those in Hopkins County have agreements with the Progressive Miners.

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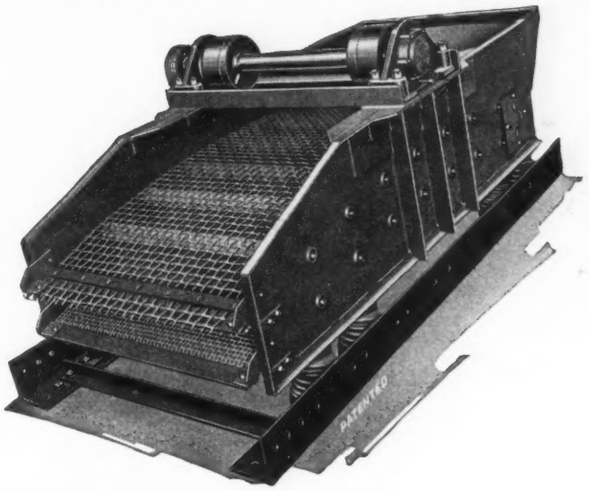
Waking Public Interest Gives Hope for Anthracite

Hope for rehabilitation of the anthracite industry through reviving public interest in the hard-coal region of Pennsylvania in its plight is seen by Alan C. Dodson, president of the Anthracite Operators' Association, who on Nov. 1 issued the following statement:

"Complete rehabilitation of the industry can never be achieved alone by producers and retailers; the rank and file of the people of the region must have a finger in the pie. What anthracite needs more than anything else is an informed and aroused public opinion. I believe it is on the way. Leading men not directly connected with the anthracite industry—bankers, publishers and business men—have waked up to the fact that the anthracite problem is the problem of the region as a whole and not of the producers alone.

"This is the position being taken by the individual anthracite producers. Accordingly, through our association, we are endeavoring to cooperate with the people of the region to the end that the industry may be rebuilt. The officers of the Anthracite Operators' Association made a personal visit to Harrisburg last week to confer with John Ira Thomas, Secretary of Mines, and Richard P. Brown, Secretary of Commerce, for the purpose of enlisting the aid and influence of the State authorities in our efforts to stabilize the anthracite situation. While it ap-

DEISTER PLAT-O VIBRATING SCREEN FOR COAL



1. Powerful high-speed vibrating mechanism.
2. Screen cloth automatically held under uniform tension.
3. Any one screening surface changed without disturbing remaining decks.
4. Cushioned vibration.

DEISTER MACHINE CO.
1933 E. Wayne St. Ft. Wayne, Ind.
Canadian Licensee and Manufacturer:
Manitoba Bridge & Iron Works, Ltd., Winnipeg

HARDSOCG

★ AUGERS
★ DRILL HEADS
★ BITS

to insure SPEED in DRILLING

Hardsocg Augers, Drill Heads, and Bits are used to excellent advantage for fast drilling of coal at mechanized mines in Northern West Virginia.
You can depend on this equipment—it is widely used—it offers you the most modern equipment for low cost results.
Hardsocg manufactures—Vertical and Horizontal Electric and Gasoline Driven Drilling Machines and Conveyor Augers for Coal Stripping Operations. Ball Bearing Differentials, Caterpillar Jack Shafts, Hydraulic Pumps, and Gathering Arm Points for Loading Machines.

HARDSOCG MANUFACTURING CO.
Ottumwa, Iowa

Doing their "BIT" ON THE WEST VIRGINIA "FRONT"!

BOWDIL CHAIN AND CUTTER BITS

. . . HELP CUT COSTS AND SPEED PRODUCTION!

● In your struggle for lower cost and higher profits, consider the use of Bowdil Cutter Chain and Bits which are found in the "model mines" of West Virginia. Shown above are two examples of this equipment—one on a giant cutting and shearing machine in the Emily Mine of the Mononghalia Rail and River Coal Corp., and below is one of the three Bowdil equipped cutting machines also in operation in the mines of the Pursglove Coal Mining Company. On such leading properties as these, only faster cutting, longer lived equipment can maintain the efficient pace required for record low-cost-per-ton production. Have you investigated the added profit potential to be found in Bowdil Cutter Chains and Bits? If not, why delay? Write us for details today.

THE BOWDIL COMPANY, CANTON, OHIO

JIM SLIM says:

HERE'S GOOD NEWS! Users of Bowdil coal cutting equipment — BARS, CHAINS, BITS — need not worry about *supply* or *price*. You will be protected on both for years to come.

BOWDIL

COAL CUTTING EQUIPMENT

pears to be an involved one, we believe that the solution of its difficulties is by no means as involved as it is supposed to be and that it can be greatly helped by the action of leading citizens in the coal fields."

In a news bulletin issued by the association on Nov. 4, John M. Meighan, executive secretary, said: "a program of information is in the making which, if properly carried out and backed by the producers, should arouse public opinion to the point where cooperation in the solution of this common problem will be a matter of course rather than one of chance. . . . But, unless the operators cooperate in putting their house in order and in improving and holding their business by every legitimate means, including widespread publicity and advertising, there is likely to be a wave of short selling instead of an enthusiastic response from the stockholders."

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Urges Study of Indiana Coals For Smoke Abatement

Increased research throughout the State to make Indiana coal and its various characteristics and possibilities known by the coal trade and to reduce air pollution was recommended in an address Nov. 1 by Charles Lammers, fuel service engineer, Chicago & Eastern Illinois R.R. His remarks were a feature of a joint luncheon meeting by the Terre Haute Chamber of Commerce and the Smoke Abatement League held at the Hotel Deming in that city.

Out of 1,500 stoker installations in Indianapolis, said the speaker, he had been informed some time ago that only 500 were burning Indiana coal. He attributed this to the fact that Eastern stoker manufacturers specified that coals with not more than 3 per cent moisture should be used with their equipment. Conceding that Midwestern coals exceeded this moisture content, he maintained that this was not detrimental to combustion. In fact, he said, the original purpose of the underfeed stoker was to burn high-volatile coals just like those found in Indiana. More detailed knowledge of Indiana coals, he added, undoubtedly would aid in increasing their consumption.

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Industrial Notes

REPUBLIC STEEL CORPORATION has appointed C. W. Ruth as director of advertising, in place of Stanley A. Knisely, who has become executive vice-president of Associated Business Papers, Inc.

JOHN A. ROEBLING'S SONS CO. has removed its New York City offices to 19 Rector St.

STERLING PUMP CORPORATION, Cleveland, Ohio, has appointed Henry J. McKenzie as executive vice-president.

HOLLUP CORPORATION, Chicago, manufacturer of welding wire and equipment, announces that the Banks-Miller Supply Co., Huntington, W. Va., is distributor for its territory.

HEWITT RUBBER CORPORATION, Buffalo, N. Y., has appointed these distributors:

Wimberly & Thomas Hardware Co., Birmingham, Ala., and Machinery & Supplies Co., Kansas City, Mo.

UNITED STATES RUBBER Co. announces that W. J. Laliberte, branch operating manager at Kansas City, Mo., is to be made branch manager at Chicago. He will succeed J. B. Spotswood, who plans to retire on Nov. 30. C. A. Gray, branch manager at Buffalo, has been transferred to Kansas City.

BUCYRUS-ERIE Co. has appointed J. E. Tait as district manager at Pittsburgh, Pa. He succeeds P. B. Heisey, who resigned to start in business for himself.

GENERAL ELECTRIC Co. has elected Charles E. Wilson, now executive vice-president, and Philip D. Reed, now assistant to the president, as president and chairman of the board of directors, respectively. They will take over their new duties on Jan. 1, succeeding Gerard Swope and Owen D. Young, who will become honorary president and honorary chairman of the board, respectively, having announced their voluntary retirement.

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H. G. Moulton Is Elected President of A.I.M.E.

Herbert George Moulton, consulting engineer, New York City, was elected president of the American Institute of Mining and Metallurgical Engineers by letter ballot of the members, according to a report by tellers at a meeting of the board of directors held Nov. 18 at the Engineering Societies Building, New York City. Also elected, according to announcement by A. B. Parsons, secretary of the institute, were two new vice-presidents: Erle V. Daveler, vice-president, Utah Copper Co., and W. M. Peirce, chief of research, New Jersey Zinc Co.; and three new directors: Holcombe J. Brown, consulting engineer, Boston, Mass.; Frank A. Wardlaw, Jr., assistant general manager, Inspiration Copper Co., and Felix E. Wormser, secretary and treasurer, Lead Industries Association, New York City. Directors John M. Boutwell, mining geologist, Salt Lake City; Karl Eilers, mining engineer, New York City, and Harvey S. Mudd, president, Cyprus Mines Corporation, Los Angeles, Calif., were reelected.

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Orchard Mine Leased

M & S Coal Co., Marion, Ill., has leased the Orchard mine, Pittsburg, Ill., and is producing at the rate of 600 tons per day. This is to be increased to 1,000 tons daily, according to Edward Mallaburn, superintendent.

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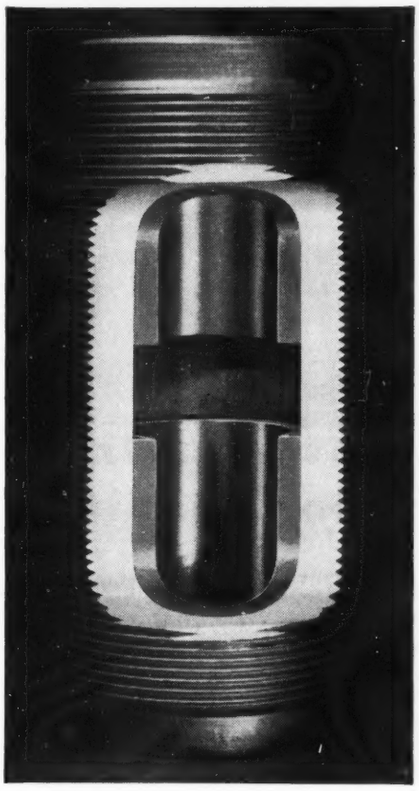
Standard Coal Reorganized

A new corporation, known as Standard Coal, Inc., has purchased the property of the Standard Coal Co., Salt Lake City, Utah, and plans resumption of operations. The new company is composed largely of bondholders of the old organization. L. E. Adams, long associated with the Spring Canyon and Royal coal companies and

THIS IMPROVEMENT

MAKES STERLING DEEP WELL PUMPS

More Trouble Free Than Ever!



• *Cut-away illustration shows cadmium-plated steel bearing with sintered, graphited liners in place.*

NOW, after months of laboratory testing and months of actual proving in the field, Sterling introduces a new drive shaft bearing!

Of cadmium-plated steel shells with sintered, graphited liners, these new Sterling Bearings retain the full tensile strength of the all-bronze bearing plus the added advantage of being lined with the *best possible bearing material!*

And because it is now "steel to steel" in Sterling Pumps, you no longer need to fear the galvanic action between bronze and steel at the shaft-enclosing tube joints.

Extra security against scored bearings is another advantage, because the graphited material will run for many hours *without any other lubrication!*

Think of these advantages. Surely they will lead you to ask questions. For further information write, wire or telephone "Pump Headquarters" at once!

STERLING PUMP CORPORATION

HAMILTON, O. **STOCKTON, CAL.**

Service (if you need it) From Coast to Coast

There are also Sterling Vertical Centrifugal Pumps, Sterling Sump Pumps, Sterling Propeller and Mixed Flow Pumps, and Sterling Jet Pumps . . . Precision Built, Yet Cost No More!

Why Mines Cut Costs with Mine-Vent Flexible Tubing

This Blower Pipe has everything to meet every mining condition

If you're not yet using Mine-Vent Flexible Tubing, just let us say this—Mine-Vent SALES are going up and up, because Mine-Vent *performance* satisfies leading mine engineers all over the country—men who want the most ventilation for the least money and demand absolutely dependable service. The Mine-Vent photo above was taken recently in a Wyoming Mine that, like so many mines, uses this tubing *exclusively*.

Check √ these exclusive features

1 Made of airtight, waterproof fabric.
2 Defies fungus, acid, powder, fumes.
3 Treated inside so air flow is always MAXIMUM.
4 Requires least "AIR-POWER."
5 Simply cut off as needed.
6 Easily installed or reclaimed.
7 A One-man proposition, unskilled labor.
8 Connects to any standard blower unit.
9 Attaches to rib or face.
10 Folds back out of way when shooting.

Send for more data and prices—today!

Patented coupling, quickly demountable. Rust-proof, air-tight. Simplifies installation, prevents waste.

AMERICAN BRATTICE CLOTH CORP.
Warsaw, Ind., U.S.A.

for the last several years their vice president and general manager, will serve in a similar capacity for the new company. The company's mine, at Standardville, it is expected, will be reopened soon with nearly 150 men employed at peak production.

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To Analyze American Progress

Industrial leaders representing more than 40,000 manufacturers affiliated in the National Association of Manufacturers and the National Industrial Council will participate in the 44th annual Congress of American Industry, Dec. 6-8, at the Waldorf-Astoria Hotel, New York City. With "A Republic Forever" as its theme, the congress will be devoted to analysis of the factors, including free enterprise and other liberties, which have contributed to the political, social and economic progress of this country. Preceding the congress, the executive officers of the 250 national, State and local industrial associations comprising the N.I.C., sponsored by the N.A.M., will hold a two-day meeting, beginning Dec. 4.

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Safety Congress for Chicago

The 1940 National Safety Congress and Exposition—the 29th—will be held Oct. 7-11 in Chicago. Col. John Stilwell, president of the National Safety Council, which sponsors the congress, announces that headquarters will be in the Stevens Hotel. The program provides for 140 distinct sessions and 500 speakers. Every phase of accident prevention will be covered. Manufacturers of safety products will have more than 125 exhibits.

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New Mine Nearly Ready

A tipple has just been completed at the new No. 4 mine of the Chafin-Jones-Heatherman Coal Co., Logan County, West Virginia. The mine, which is nearly ready for operation, will be fully mechanized, two conveyors already having been installed.

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Mine "B" Resumes Operation

Hoisting of coal began at Mine B of the Mine B Coal Co., Springfield, Ill., on Nov. 9 after an idleness of two years. Carl Elshoff, president of the company, said employees would be accorded the same wages, hours and working conditions as were in existence between the Progressive Miners and the Illinois Coal Producers' Association.

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Progressive Reinstated

The National Labor Relations Board on Nov. 14 ordered the Kelleys Creek Colliery Co., Ward, W. Va., to cease discouraging membership in the Progressive Mine Workers and to reinstate with back pay a miner discharged by the company for the purpose of discouraging member-

ship in that organization. Continuance of his employment is made by the Board's order subject to the provision of any valid open-shop contract which may now exist between the company and the United Mine Workers.

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Scandia Labor Trouble Ended

A labor dispute between the Scandia Coal Co., Madrid, Iowa, and its employees which had lasted seven months has been settled. The new agreement, which settled the wage rate for miners who do conveyor loading, will return about 100 men to work at the company's No. 4 mine. The operation, which was closed on May 4, resumed pick-mining on Sept. 12 with about 250 miners.

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Fires Damage Harlan Plants

One hundred and forty men were thrown out of work and a loss estimated at $60,000 was caused when fire destroyed the tipple of the R. C. Tway Coal Co. on Martin's Fork Highway near Harlan, Ky., on Oct. 25. Mine officials reported the telephone line between the tipple and the superintendent's home was found cut and a nozzle for a fire hose was missing. The mine watchman reported an odor of gasoline at the scene when he discovered the blaze.

Destruction of the headhouse of the Harlan Collieries Co., Brookside, Ky., by fire on Nov. 2 put 350 men out of work.

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Trade Literature

ANTI-FREEZE FOR AIR LINES—Sullivan Machinery Co., Michigan City, Ind. Bulletin R-16 describes Tannergas for temporary air-compressor installations or where electric current is not available; Frosto for permanent installations where electric current can be obtained, and Frosto Vaporizer for portable compressors. All types, according to the manufacturer, are guaranteed to prevent freezing to 70 deg. below zero.

AUTOMATIC STORAGE CONTROL—Stephens-Adamson Mfg. Co., Aurora, Ill. Bulletin 1239 describes the Tellevel control for starting and stopping conveyors feeding bulk materials to bins or hoppers, and for opening and closing valves feeding liquids into tanks. Illustrations show wiring, dimensions and operation.

BELT-DRIVE DATA—American Leather Belting Association, New York City. Data book represents the cooperation of 46 manufacturers to make it easy to select short-center motor drives. Advantages of these drives are presented, as well as proofs of long life and efficiency of leather belts, gathered from more than 100 plants.

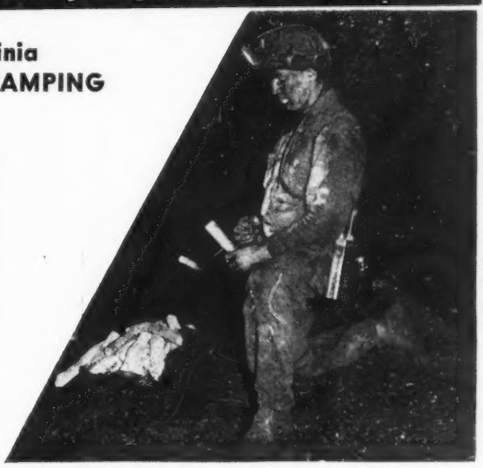
BELT FASTENERS—Flexible Steel Lacing Co., Chicago. Bulletin No. V-200 covers a new line of alligator V-belt fasteners for "B," "C," and "D" section V-belts, to be used only on cross-woven fabric V-belts and not to shorten or repair stretched-out or broken endless-cord V-belts. The bulletin shows how the fas-

Less costly to use

SEAL-TITE TAMPING BAGS

and you get safer BLASTING

Large Northern West Virginia operators use SEAL-TITE TAMPING BAGS with great success



SEAL-TITE Tamping Bags cut mining explosive costs because their seams are stronger—no opening of seams on account of moisture. They are available in 65 different stock sizes for all needs. You can get the size you want from stock as needed.

Used with "the Dummy Maker"

"The DUMMY MAKER" and 2 helpers can pack 400 to 600 bags an hour. This efficient machine pays for itself quickly—no complicated machinery — easy to use—dependable—steps up working efficiency—saves time and costly skilled labor —ruggedly built to withstand constant use—uses clay, or sand for stemming material—mounted on trucks for portability—operates on ¼ h. p. motor.

SEAL-TITE KRAFT 100%

Our guarantee of Satisfaction

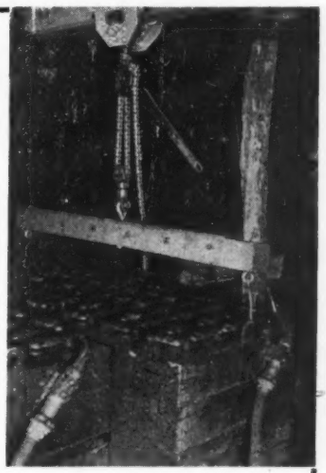
THE TAMPING BAG COMPANY **MT. VERNON, ILL.**

NORTHERN WEST VIRGINIA MINES PROVE VALUE OF

COFFING *Safety Pull*

RATCHET LEVER HOIST . .

This new hoist is ideally suited for handling storage batteries from shuttle cars and lifting them back on again after charging. But, that isn't all—there are unlimited uses for this safe, dependable hoist all about mines—wherever there is a lift or pull needed. They make possible remarkable savings for users and speed up the various jobs of lifting and pulling. New safety features make them foolproof.



This hand operated Coffing Safety Pull Ratchet Lever Hoist is used to lift the batteries out of the car to charging location and back into car after they are charged, at Laura Lee Mine.

COFFING ADVANCED DESIGN **HOISTS**

SPUR GEAR • RATCHET LEVER • ELECTRIC

Illustration at left shows miner lifting storage batteries into a shuttle car at Consolidation Coal Company's mine No. 25 with a Coffing.

There is a Coffing distributor near you who will demonstrate these new hoists—*write for his name.*

COFFING HOIST COMPANY

DANVILLE, ILL.

TRAMP IRON MAGNETS

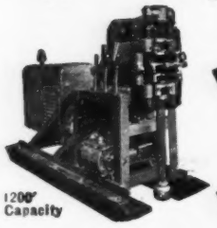
● To be located in chutes, shaker screens, ends of loading booms or conveyors for the certain removal of tramp iron and steel during the processing of coal. They safeguard your machinery from damage . . . and assure clean, metal-free fuel for your industrial or domestic customers.

Three poles, energized by a thoroughly insulated coil. Furnished with sufficient tapped holes for quick and easy installation . . . or made to order for unusual applications. For direct current only . . . 110 to 600 volt.

May we send descriptive bulletin and prices? We will also furnish a list of users if desired.

CENTRAL ELECTRIC REPAIR COMPANY
622 GASTON AVE., FAIRMONT, W. VA.

● *Have your*



DIAMOND CORE DRILLING

done with our light gasoline drills. They save fuel and moving costs.

Standard 2¼" Coal Cores. Holes to 1200' Depth. We guarantee satisfactory and proper coal cores.

Cored Ventilating Shafts drilled. Pre-Pressure Grouting for proposed mine shafts. Solidification of Wet Main Entries, done by our Stop-Grout Method.

Water Wells and Discharge Holes drilled and grouted.

MOTT CORE DRILLING COMPANY
HUNTINGTON **W. VA.**

teners are applied and illustrates various types of applications.

COMPRESSORS—Chicago Pneumatic Tool Co., New York City. Bulletin 767 covers Class W-CO stationary diesel-driven compressors, citing advantages and engineering data.

CONTROLS—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Descriptive Data 11-840 describes heavy duty skip-hoist controllers for squirrel-cage motors. Descriptive Data 15-020 covers new line of standard-duty pushbuttons for a.c. and d.c. pilot circuits, including one-, two- and three-button stations, and also units for special uses, with watertight covers, flush mounting, rotary selector switch or safety latch to protect against accidental operation.

ELECTRICAL EQUIPMENT—General Electric Co., Schenectady, N. Y. GEA-98B, Type RB, single-phase, repulsion, brush-shifting motor. GEA-821G, pressure and vacuum switches, CR2927, diaphragm type. GEA-1698A, wound-rotor induction motors, Types M and MT. GEA-1907B, squirrel-cage induction motors, Frames 542 to 579. GEA-1945A, synchronous motor-generator sets. GEA-2150B, Diactor generator-voltage regulators, Type GDD. GEA-3226, demand meters. GEA-3228, gas absorbers and vent pipes for Pyranol transformers. GEA-3268, circuit breakers. GEA-3279, Diactor generator-voltage regulators, Type GDA.

FLAME CLEANING AND DEHYDRATING—Air Reduction Sales Co., New York City. Form No. ADG-1066 discusses the use of this process to halt deterioration of old steel structures by means of paint burning and surface conditioning. Sections describe apparatus, regulation of speeds and suggested specifications for various surfaces of metal.

SHOVELS AND DRAGLINES—Bucyrus-Erie Co., South Milwaukee, Wis. Bulletin No. 33B-3 describes modern improvements in the 33-B 1¼-yd. shovel-dragline-clamshell-crane. Bulletin No. DL-1 covers the mechanical and structural details of draglines in various sizes, illustrated with halftones. Bulletin No. D-1007, on the 100-B 4-yd. electric shovel and dragline, explains its construction, use of modern alloy steels, Ward Leonard control, digging action, operating range, full-revolving advantages, great mobility and easy convertibility to dragline or crane.

—✣—

Mine Accident Fatality Rate Wanes Slightly

Accidents at coal mines in the United States caused the deaths of 94 bituminous and 15 anthracite miners in September last, according to reports furnished the U. S. Bureau of Mines by State mine inspectors. With a production of 37,695,000 tons, the death rate among bituminous miners was 2.49 per million tons, compared with 2.82 in the corresponding month of last year.

The anthracite fatality rate in September last was 3.14, based on an output of 4,776,000 tons, against 2.36 in September, 1938.

For the two industries combined, the death rate from accidents in September last was 2.57, compared with 2.78 a year ago.

Fatalities during September last, by causes and States, as well as comparable rates for the first nine months of 1938 and 1939 are shown below:

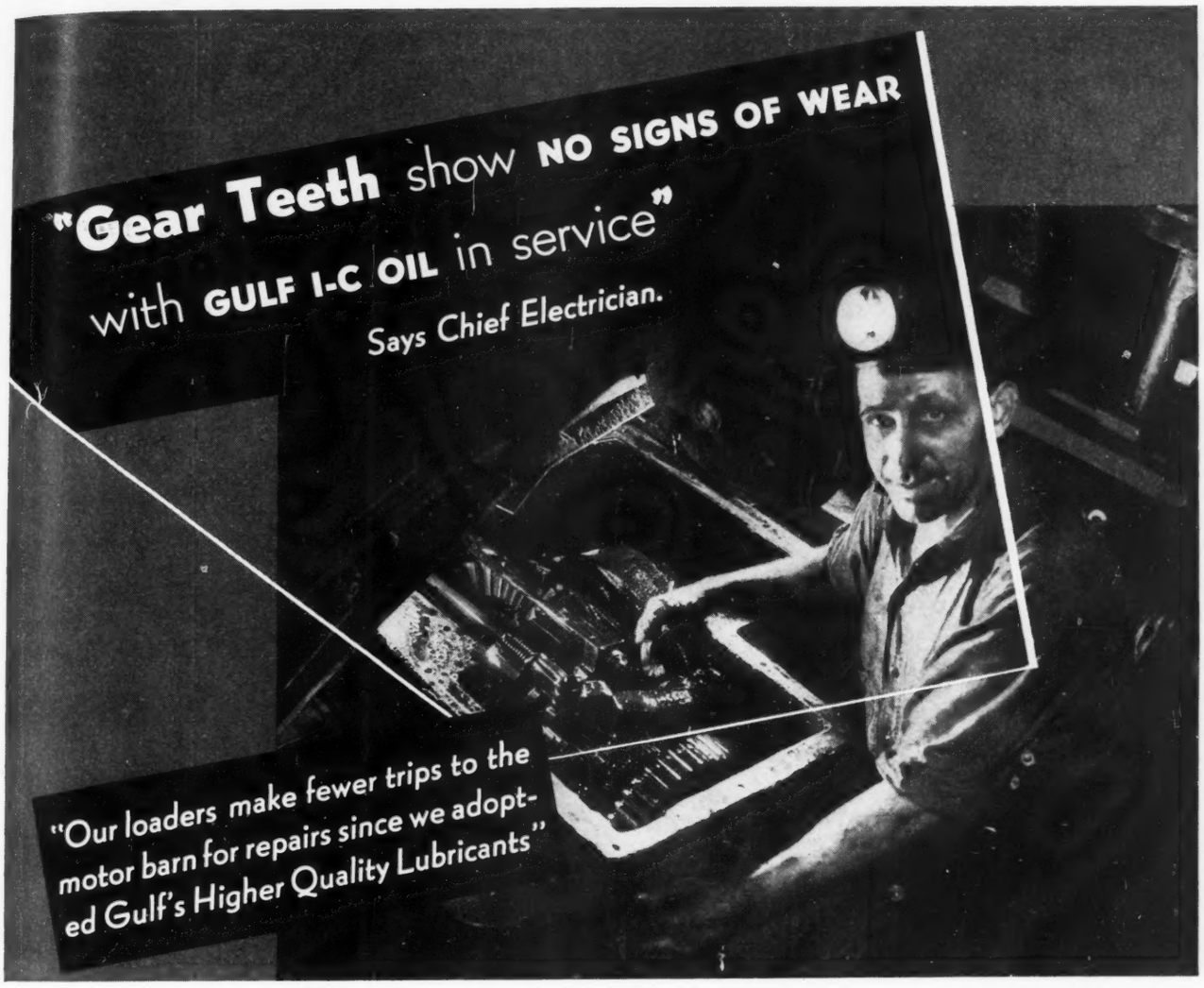
UNITED STATES COAL-MINE FATALITIES IN SEPTEMBER 1939, BY CAUSES AND STATES

	Underground									Open-Cut and Surface					
State	Falls of Roof	Falls of Face	Haulage	Gas or Dust Explosions	Explosives	Electricity	Machinery	Mine Fires	Total Underground	Mine Cars	Railway Cars	Electricity	Other Causes	Total Surface	Grand total
Alabama	2	..	..	1	..	..	..	..	3	....	....	....	....	....	3
Arkansas	2	..	..	1	..	..	..	..	3	....	....	....	....	....	3
Colorado	3	..	1	..	..	..	..	..	4	....	....	1	....	1	5
Illinois	3	..	3	..	1	..	..	..	7	....	....	....	....	....	7
Iowa	3	..	1	..	..	..	..	..	4	....	....	....	....	....	4
Kansas	..	..	..	..	..	..	..	..	..	....	....	....	2	2	2
Kentucky	6	..	3	..	..	..	1	2	12	....	....	....	....	....	12
Ohio	2	..	..	..	1	1	..	..	4	....	....	....	....	....	4
Oklahoma	..	..	..	..	..	2	..	..	2	....	....	....	....	....	2
Pennsylvania (bit.)	10	2	..	..	..	1	..	..	13	....	....	....	....	....	13
Utah	2	..	..	..	..	..	..	..	2	....	....	....	....	....	2
Virginia	3	..	2	..	..	..	..	..	5	1	....	....	....	1	6
West Virginia	15	3	5	..	..	4	1	..	28	1	1	....	1	3	31
Total (bituminous)	51	5	15	2	2	8	2	2	87	2	1	1	3	7	94
Pennsylvania (anthracite)	10	1	4	..	..	..	..	..	15	....	....	....	....	....	15
Grand total	61	6	19	2	2	8	2	2	102	2	1	1	3	7	109

FATALITIES AND DEATH RATES AT UNITED STATES COAL MINES, BY CAUSES *
January–September, 1938 and 1939

	Bituminous				Anthracite				Total			
	Number Killed		Killed per Million Tons		Number Killed		Killed per Million Tons		Number Killed		Killed per Million Tons	
Cause	1938	1939	1938	1939	1938	1939	1938	1939	1938	1939	1938	1939
Underground:												
Falls of roof and coal	339	315	1.443	1.199	92	89	2.739	2.337	431	404	1.605	1.343
Haulage	116	94	.494	.358	16	22	.476	.577	132	116	.492	.385
Gas or dust explosions:												
Local	17	8	.072	.030	2	3	.060	.079	19	11	.071	.037
Major	60	28	.255	.106	18	...	.536	.....	78	28	.290	.093
Explosives	21	8	.090	.030	11	12	.328	.315	32	20	.119	.066
Electricity	33	32	.140	.122	2	2	.060	.052	35	34	.130	.113
Machinery	16	15	.068	.057	...	...	.....	.....	16	15	.060	.050
Shaft	4	2	.017	.008	3	4	.089	.105	7	6	.026	.020
Miscellaneous	15	10	.064	.038	9	8	.268	.210	24	18	.089	.060
Stripping or open-cut	5	6	.021	.023	8	4	.238	.105	13	10	.049	.033
Surface	21	21	.090	.080	8	11	.238	.289	29	32	.108	.107
Grand total	647	539	2.754	2.051	169	155	5.032	4.069	816	694	3.039	2.307

* All figures subject to revision.


"Gear Teeth show NO SIGNS OF WEAR
with GULF I-C OIL in service"
Says Chief Electrician.
"Our loaders make fewer trips to the motor barn for repairs since we adopted Gulf's Higher Quality Lubricants"

"WE regard the use of Gulf's higher quality lubricants as a *real economy* in our mine," says this mine manager. "Here is the reason: If a mechanical loader should break down, it would mean idleness for 16 men—and we can't afford such costly delays. But with the Gulf engineer on the job we avoid them! His recommendations have helped us keep our equipment operating at peak efficiency."

Gulf's higher quality oils and greases will help you improve the operation of all your equipment. Under severe operating conditions they prove their endurance and resistance to decomposition. These better lubricants help operating men step up production schedules and cut down costs for maintenance. Less time is lost for adjustments and repairs after your equipment has been checked over by an experienced Gulf lubrication engineer and his recommendations adopted.

Gulf's higher quality oils and greases are quickly available to you through more than 1100 Gulf warehouses in 30 states from Maine to Texas. Write or 'phone your nearest distribution point today.

The Gulf engineer is familiar with the lubrication requirements for each type of mechanical loader and will recommend the oils and greases which best provide for the conditions under which your loaders work.

GULF INDUSTRIAL LUBRICATION

Gulf Oil Corporation - Gulf Refining Company

GENERAL OFFICES: GULF BUILDING, PITTSBURGH, PA.

GET YOUR MONEY'S WORTH

READ OVER, once again, that list of features. They're the features to look for if you want to save money on cable repairs and stop production delays and power losses.

They're the features you get—*all of them*—when you use RU-BER-OID Insulating Tape. And all these features combined mean long life and sound economy.

This heavy duty, double grip tape *stays put* regardless of climate or temperature. It *provides* thorough insulation in one extra-thick covering—*resists* acids, alkali and moisture—*lasts* in spite of abrasion by sharp coal. Grimy or oily hands fail to loosen its grip.

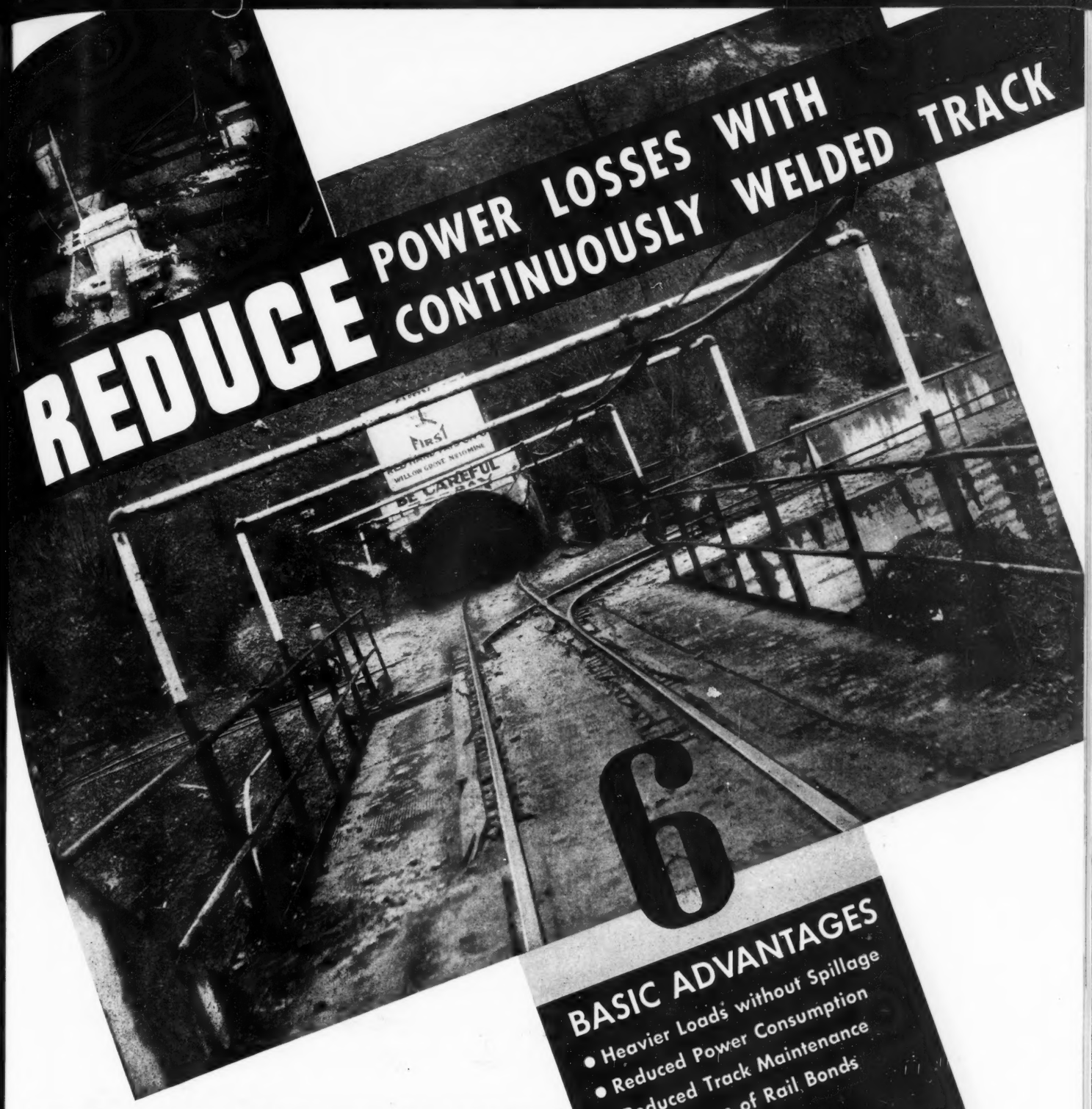
Your supply house has RU-BER-OID Insulating Tape. Specify it. Use it—and find *all* the time-saving, money-saving features.

RU-BER-OID INSULATING TAPE

OTHER RU-BER-OID PRODUCTS FOR COLLIERIES

ROLL ROOFING
ASBESTOS-CEMENT SHINGLES
ASPHALT SHINGLES
INSULATING PAINTS
BUILT-UP ROOFS
ASBESTOS INSULATIONS
ASBESTOS PIPE COVERINGS
ROOF COATINGS
PATCHING PLASTIC
CORRUGATED ASBESTOS-CEMENT ROOFING AND SIDING

THE RUBEROID CO., EXECUTIVE OFFICES: 500 FIFTH AVENUE, NEW YORK



By eliminating rail joints, and doing away with the need for rail bonds, Thermit welded track can reduce your power losses to a minimum.

Thermit welds have electrical conductivity equal to that of the rail itself. In fact, approximately 20% greater conductivity is obtained in Thermit welded track than in new track bonded in the usual way. And, this high conductivity of Thermit welds is permanent. It remains the same as long as the rail is in service. Power losses can never develope, as they do where there are plates and bonds to corrode and become defective.

You don't need to make a detailed study to determine these facts. Just visit a mine where Thermit welded track is installed and see how locomotives pick up pep on the welded stretches.

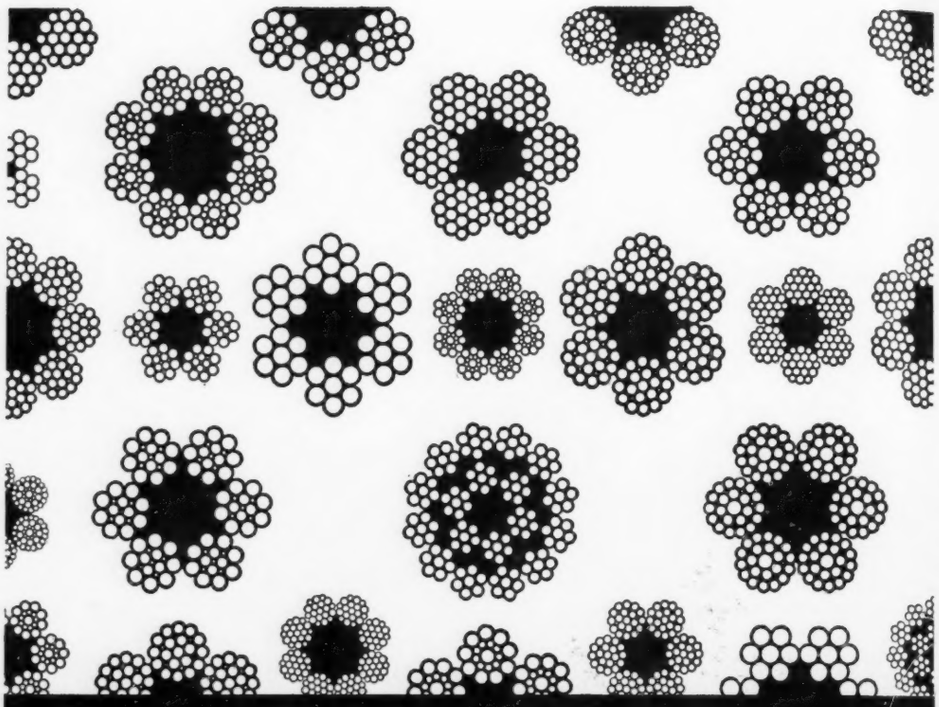
For more detailed information on Thermit Rail Welding, write for the pamphlet, "Continuous Rail for Main Haulage Track," or ask to have a representative call. No obligation, of course.

6 BASIC ADVANTAGES

- Heavier Loads without Spillage
- Reduced Power Consumption
- Reduced Track Maintenance
- Elimination of Rail Bonds
- Increased Rail Life
- Faster Haulage

THERMIT Rail WELDING

METAL & THERMIT CORPORATION, 120 BROADWAY, NEW YORK, N. Y.
ALBANY • CHICAGO • PITTSBURGH • SO. SAN FRANCISCO • TORONTO



ALL CONSTRUCTIONS AND SIZES ARE MADE IN WISSCOLAY PREFORMED

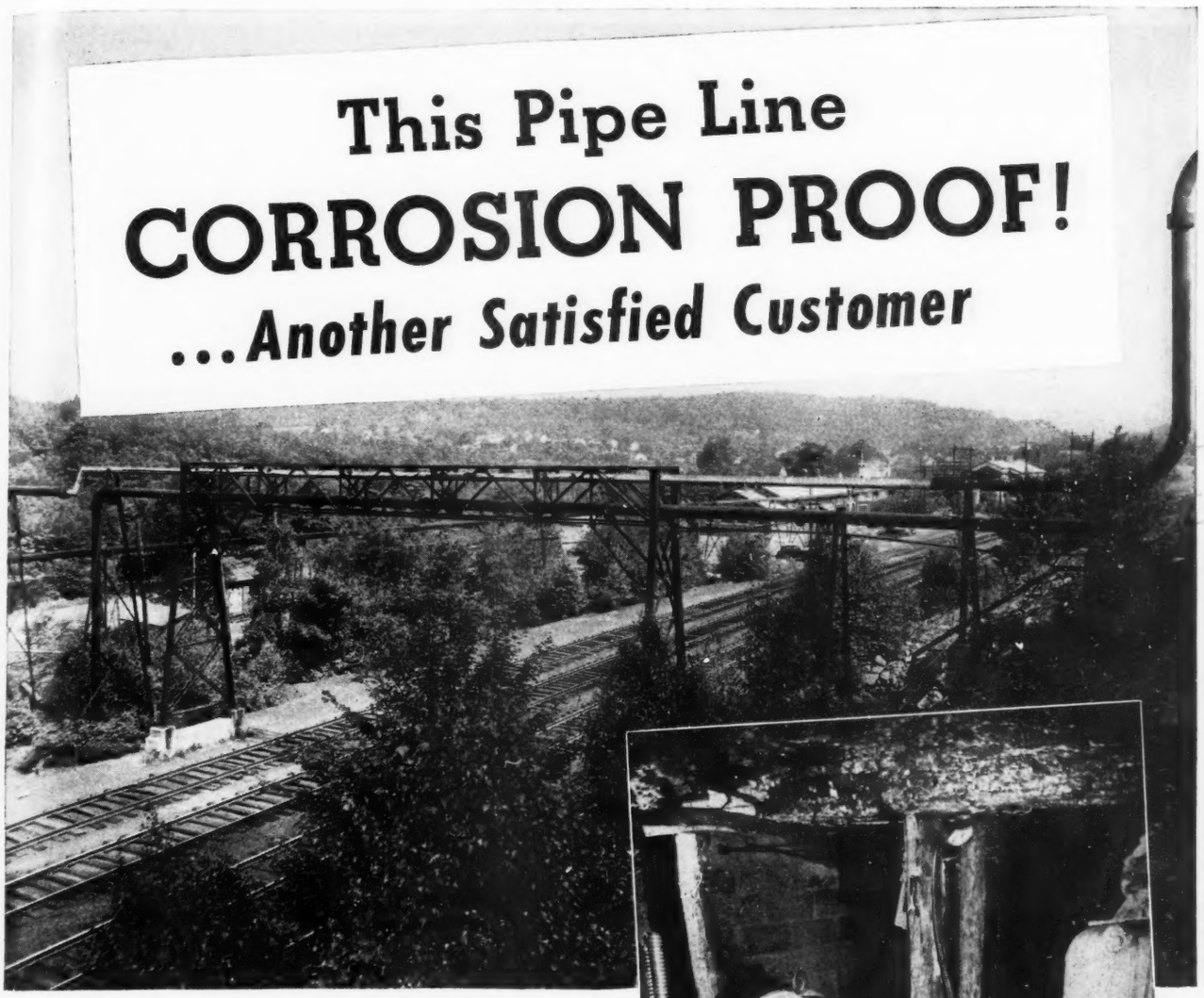
Rope quality is important . . . but construction to meet conditions of use is likewise essential in reducing rope costs. Number of strands, relative sizes of wires, nature of core and kind of metal must be correctly combined to give you the longest possible rope life. You can get exactly the best combination for your use in Wisscolay Preformed. And as for quality . . . there is no better rope made than WICKWIRE ROPE.

WICKWIRE ROPE

WICKWIRE SPENCER STEEL COMPANY

General Offices: 500 Fifth Avenue, New York City; Sales Offices and Warehouses: Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles, Tulsa, Chattanooga, Houston, Abilene, Texas, Seattle. Export Sales Department: New York City

This Pipe Line CORROSION PROOF! ...Another Satisfied Customer

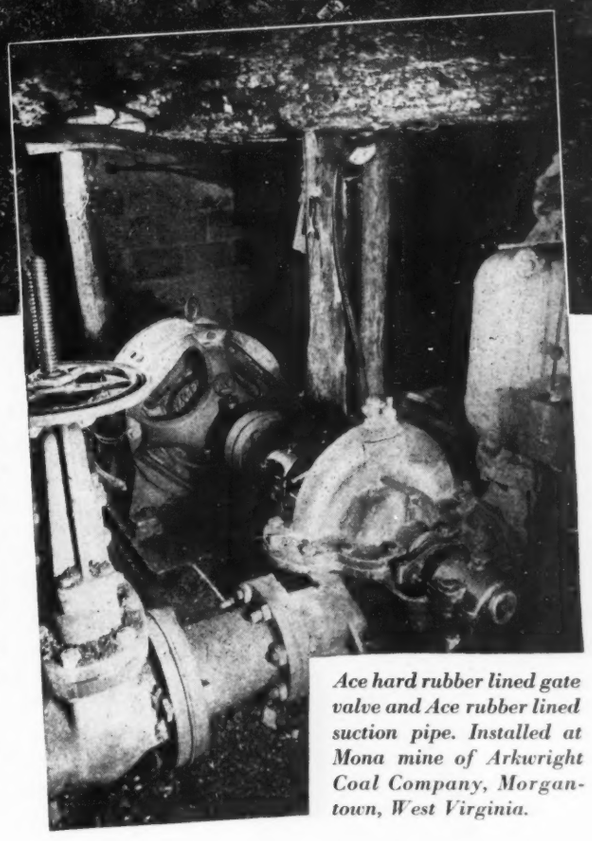


Above: Corrosion proof Ace rubber lined discharge line

ACE *corrosion and abrasion resisting* soft **RUBBER LINED** pipe and fittings, with extra heavy flanges, has carried acid mine water continuously in this 145 ft. discharge line for 8 years. And, many more years of service are indicated.

This record of uninterrupted service... without repairs or replacements... is only one of many showing how ACE equipment has paid its way in acid mine water handling.

Let our Engineers show you how to make such an investment at small cost. Catalogue will be gladly sent, on request, without obligation.



Ace hard rubber lined gate valve and Ace rubber lined suction pipe. Installed at Mona mine of Arkwright Coal Company, Morgantown, West Virginia.

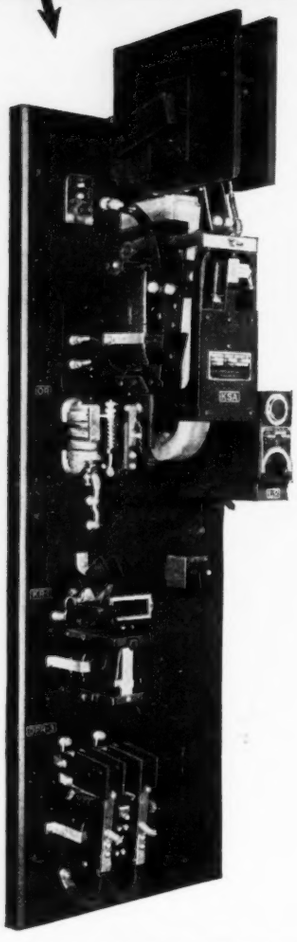
ACE RUBBER *Prevents Corrosion*

AMERICAN HARD RUBBER COMPANY, 11 MERCER STREET, NEW YORK, N. Y.

AKRON, OHIO • 111 WEST WASHINGTON STREET, CHICAGO, ILLINOIS

In mechanized mines . . .
of Northern West Virginia

I-T-E AUTOMATIC RECLOSING CIRCUIT BREAKERS



This Type KSA Automatic Reclosing Circuit Breaker is typical of the I-T-E equipment in the Maiden Mine and in the substations of many other mines in northern West Virginia.

I-T-E Automatic Reclosing Circuit Breakers play an important part in the mechanized mines of northern West Virginia.

In all five substations of the Maiden Mine, Kelleys Creek Colliery Co., near Morgantown, Type KSA circuit breakers are used to protect the important feeder circuits. Similar installations are found in most of the other mines in the northern West Virginia field.

In this field, also, the use of the Type KSC circuit breaker for automatic sectionalizing of underground circuits is increasing. In keeping with present-day practice of protecting mechanized sections with sectionalizing circuit breakers, the operators in this area have accepted the Type KSC for its ruggedness and dependability.

Some of the more important advantages of sectionalizing are:

Low cost of the circuit breaker in comparison with the money value of the electrical and mechanical equipment protected in each section.

Increase in production by confining electrical disturbances to the sections in which they arise.

Decrease in power demand and in total energy consumed.

Reduced hazards of fire and explosion.

Reduced maintenance by preventing abusive operation of equipment under serious overload or on low voltage.

Bulletins are available detailing the advantages of both the Type KSC and KSA Automatic Reclosing Circuit Breakers, based on installations in active mines.

Representatives in Principal Mining Areas

I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.

PUT THE BRAKES ON HIGH ROPE COSTS!

Lowest general-average rope operating cost is assured through the use of Roebling "Blue Center" Wire Rope. The result of continuous research and development, this rope is the finest product of Roebling's unexcelled research, steel-making and rope-fabricating facilities. Ask about Roebling's "Blue Center" Wire Rope ... either standard or preformed.

JOHN A. ROEBLING'S SONS COMPANY, TRENTON, N. J.
BRANCHES IN PRINCIPAL CITIES

STRONGER—Wire of highest strength consistent with ductility and toughness

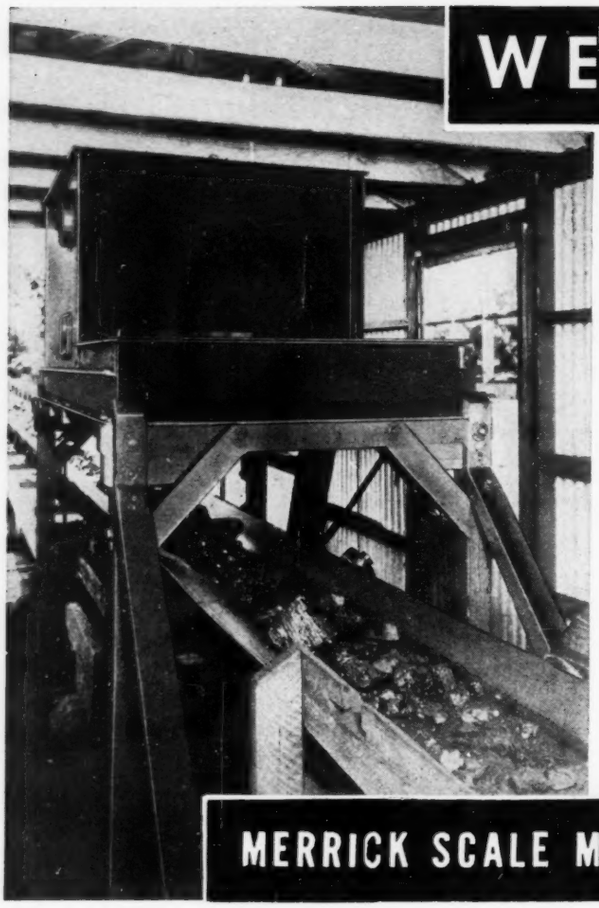
TOUGHER—Provides maximum resistance against wear, sudden shocks, vibration

SAFER—Unequalled for uniformity of quality

SAVING—Insures lowest general average operating cost

THE HIGHEST DEVELOPMENT IN ROEBLING WIRE ROPE

WEIGHTOMETER



Let us help you with *Low Cost Production* with MERRICK WEIGHTOMETERS. They assure accurate and speedy weighing for control of tonnage and efficiency of operation:

Weighing all coal from pits or mines to Washing plants.

Weighing coal after cleaning.

Weighing waste and rejects.

A Weightometer for every requirement of the industry. May be applied to existing belt conveyor or furnished complete with short pivoted conveyor.

Among prominent users are:

Bell & Zoller Coal & Mining Co.
Berwind White Coal Mining Co.
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Emerald Coal Mining Co.
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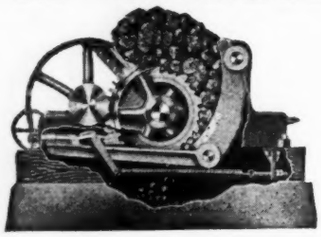
Weirton Coal Co.
Peabody Coal Co.
Delta Coal Mining Co.
St. Nicholas Breaker
Phila. & Reading Coal Co.

MERRICK SCALE MFG. CO., PASSAIC N. J., U. S. A.

COAL CRUSHERS



We build a type and size for every coal crushing requirement. 100 years of experience is your assurance that we know how. Quotations on request.

McLANAHAN & STONE CORP.
Established 1835 HOLIDAYSBURG, PENNA.

PERFORATED METAL
COAL MINING SCREENS
Manufactured exactly to your specifications
Any size or style screen, in thickness of steel wanted with any size perforation desired.
We can promptly duplicate your present screens at lowest prices.

CHICAGO PERFORATING CO.
2443 West 24th Place
CHICAGO, ILLINOIS
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THE PURE

PURE THREE POINT LUBRICATION • A Complete Line of Industrial Petroleum Products

THE PURE OIL COMPANY, U.S.A. — PURE — THREE POINT LUBRICATION SERVICE — INDUSTRIAL DEPT. — CRUDE

Ask a Pure Oil Engineer to help solve your lubrication problems

OIL CO.
CHICAGO, U.S.A.

Keep the mine cars rolling

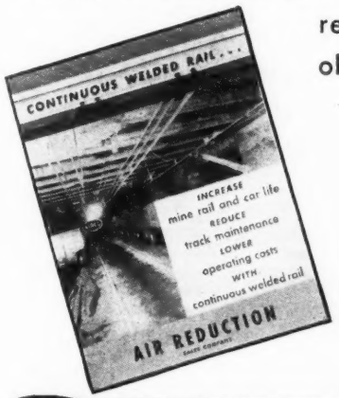
...with AIRCO welding and cutting apparatus and supplies

(Upper) Airco gas welding apparatus in use in a maintenance shop of the Pursglove Coal Mining Company, and (lower) in the car rebuilding shop at Jamison Coal and Coke Company's No. 8 mine.

SMOOTH track...sturdy cars...strong equipment . . . long life . . . low power consumption . . . all are necessary to keep the cars moving — to successfully operate a mine.

An Airco welding and cutting outfit is all that is needed to make practically every repair, either in the mine or in the shop. It can also be used economically to fabricate new equipment and many replacement parts for old equipment. When used with Airco High Purity Oxygen, Acetylene and time-proved methods, best results — at lowest cost — are assured.

Our Applied Engineering Department will gladly assist our customers in all problems involving the use of the oxyacetylene process in and around the mine. If you haven't received a copy of the new "Continuous Welded Rail" bulletin, ask any Airco office or representative for this interesting and helpful booklet.



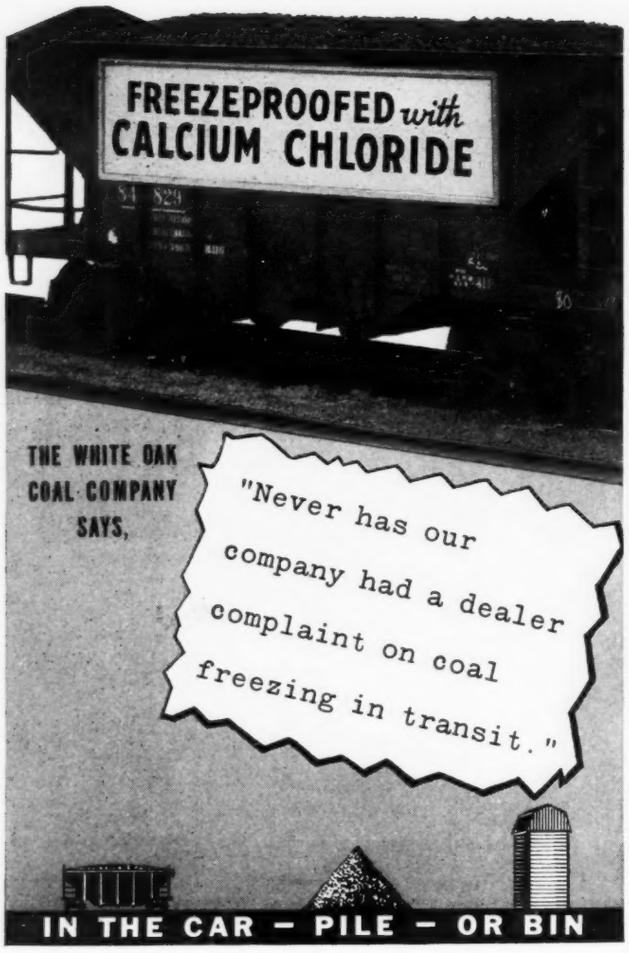
AIR REDUCTION

SALES COMPANY

General Offices: 60 EAST 42nd ST., NEW YORK, N. Y.,

DISTRICT OFFICES IN PRINCIPAL CITIES

AIRCO *Anything and Everything for* GAS WELDING or CUTTING and ARC WELDING WILSON


FREEZEPROOFED with CALCIUM CHLORIDE
THE WHITE OAK COAL COMPANY SAYS,
"Never has our company had a dealer complaint on coal freezing in transit."
IN THE CAR — PILE — OR BIN

WINTER brings new problems to both mine owner and coal dealer. The dealer who got ten carloads of solidly frozen coal during a fuel shortage knows all about it. He now demands coal treated with calcium chloride because it's not only dustproofed, but freezeproofed as well.

Dustless coal is no longer a specialty. It's a commodity. Householders demand it. You might as well get freezeproofing along with the dustproofing agent. You can get it by using calcium chloride. It freezeproofs coal in the car, the pile, or the dealer's bin.

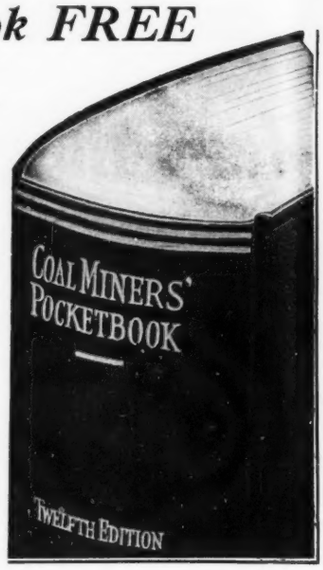
Write for literature on how much to use and how to use it.

•

CALCIUM CHLORIDE ASSOCIATION
4145 PENOBSCOT BLDG., DETROIT, MICH.

CALCIUM CHLORIDE
KEEPS COAL DUSTLESS

Your name stamped on this book FREE



At no additional cost to you, we will stamp your name, or a friend's name, in gold on the front cover of any copy of the Coal Miners' Pocketbook ordered from this advertisement. This is a special Christmas offer, limited to acceptance before January 1, 1940.

Twelfth Edition

Coal Miners' Pocketbook

Edited by E. N. Zern
Assisted by a staff of specialists

1400 pages, pocket-size illustrated, flexible, $6.00

THIS great standard reference work covers every phase of coal mining, from prospecting to preparing coal for the market—from scientific fundamentals to mine ventilation and drainage. Cutting, loading and conveying machinery is described. Hundreds of practical methods and tips on mine working, erecting timbers hoisting, haulage, etc. — elements of mathematics, mechanics, hydraulics, etc.—tables, definitions, formulas, charts and illustrations in profusion — over 2,000 facts that you need constantly have been assembled by experts in handy form in this book.

—weights and measures
—mathematics
—mechanics
—strength of materials
—specific gravity, weight and other properties of materials
—hydrostatics
—hydraulics
—concrete
—masonry
—heat and fuels
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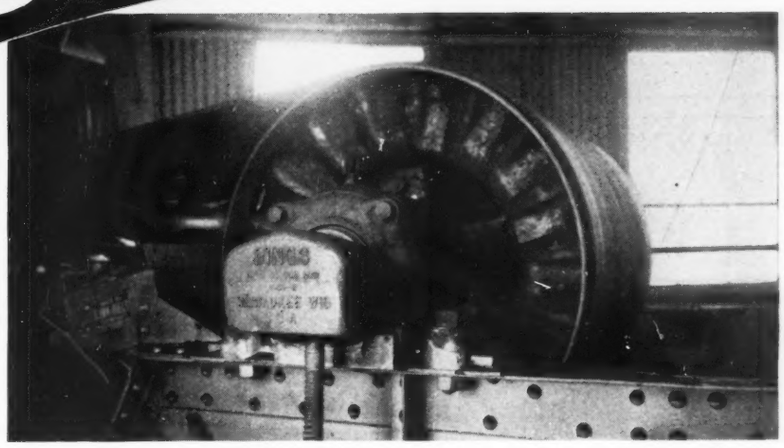
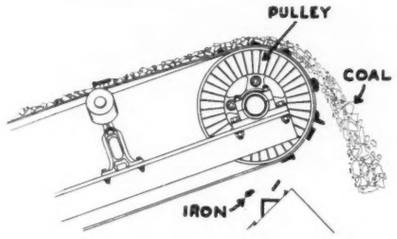


Right: Ding's *High Intensity* air cooled Magnetic Pulley removing iron from coal at Union Pacific Coal Co. mines, Superior, Wyoming.

HOW IT WORKS:



Replacing the head drive pulley on your present belt conveyor, the Dings High Intensity Magnetic Separator attracts all iron to the belt surface where it adheres, travels to the underside and discharges.

Simple and positive in operation, Dings require no costly readjustment in present coal handling methods.

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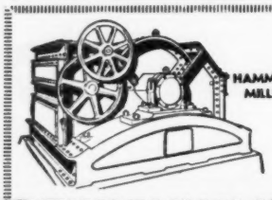

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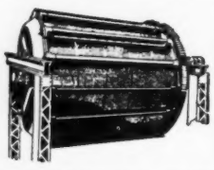

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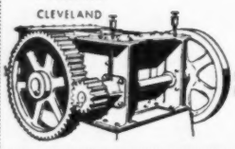

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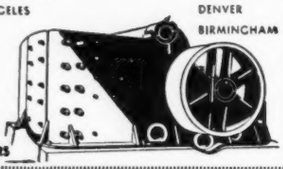

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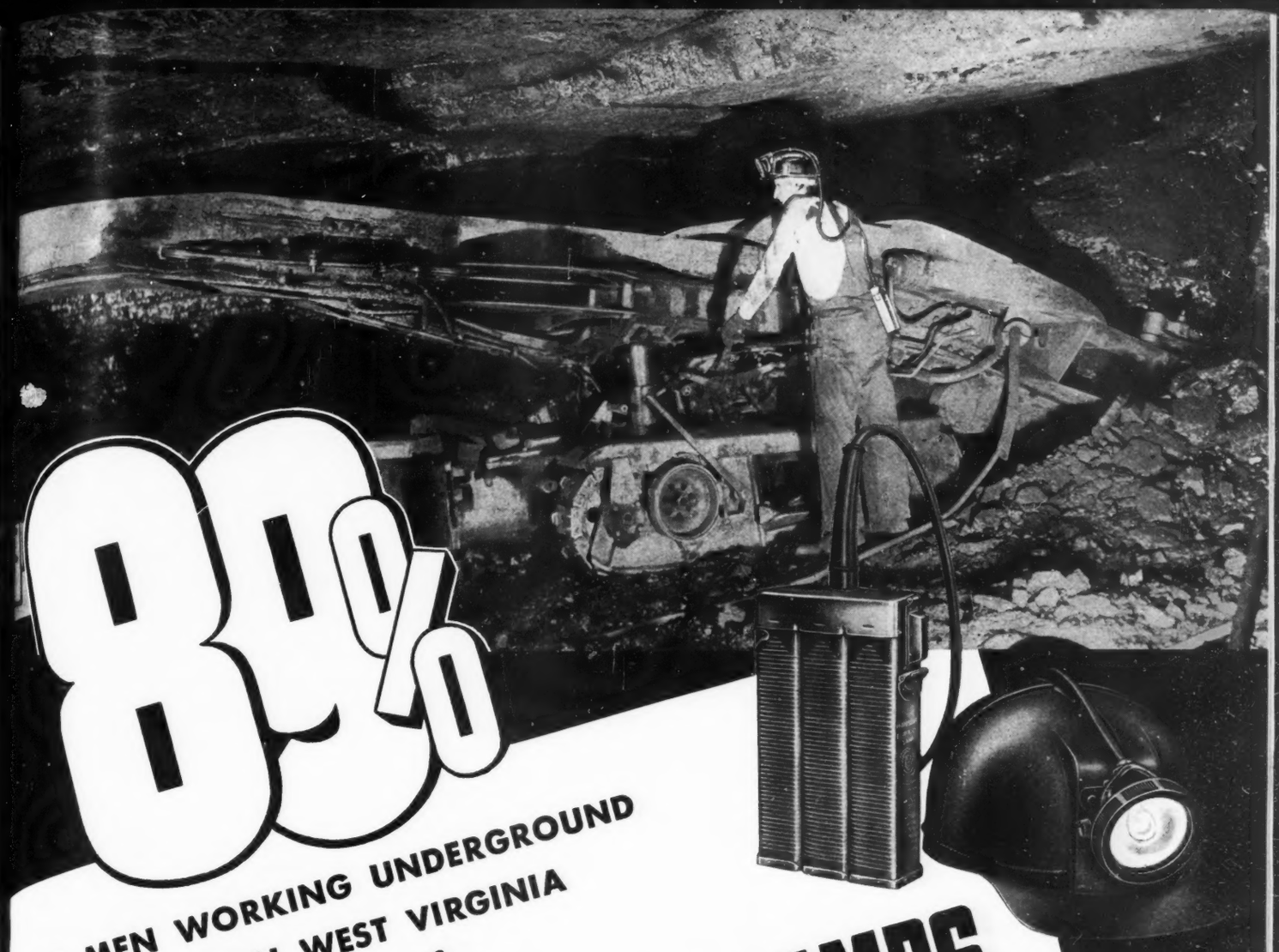

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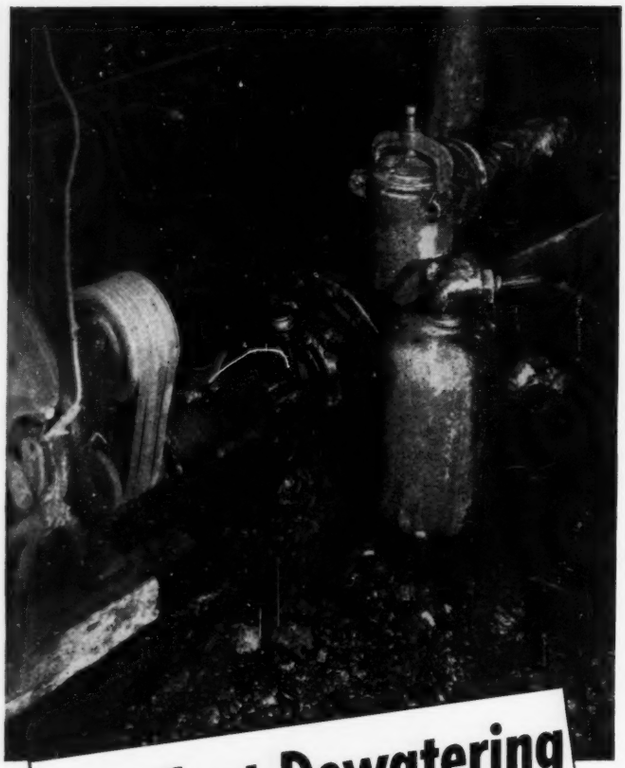

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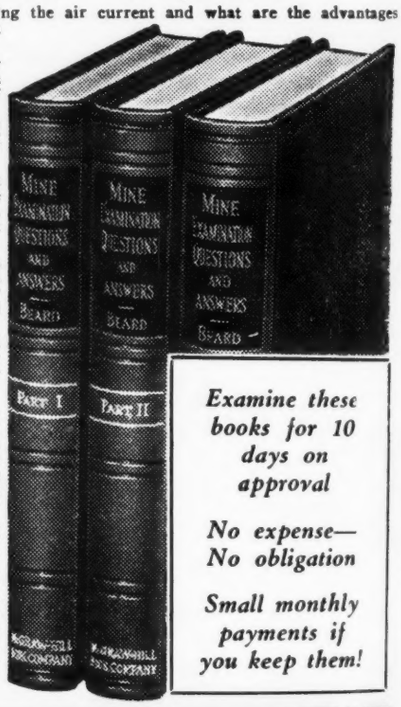
What are the advantages and disadvantages of a gasoline pump, an air pump and an electrical pump?

What is the estimated tonnage per acre, per foot of thickness, for bituminous coal?



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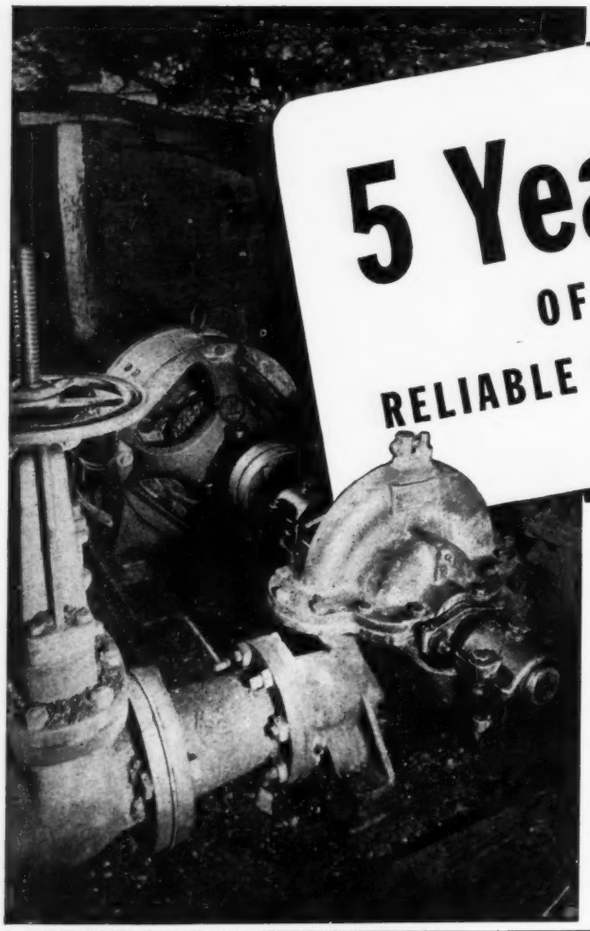

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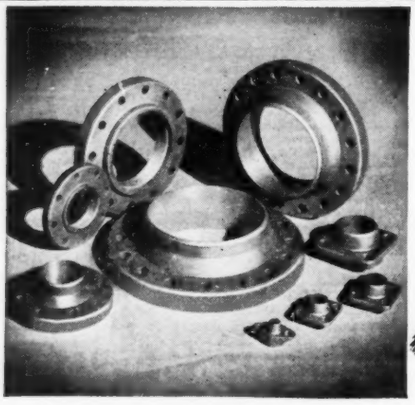

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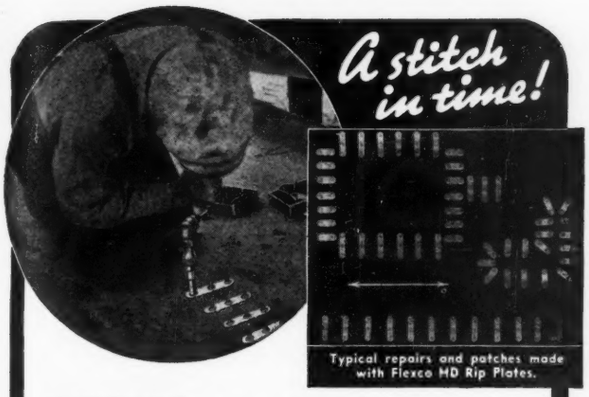

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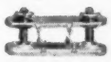
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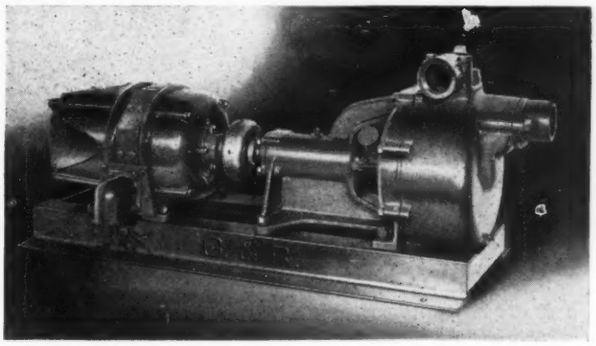

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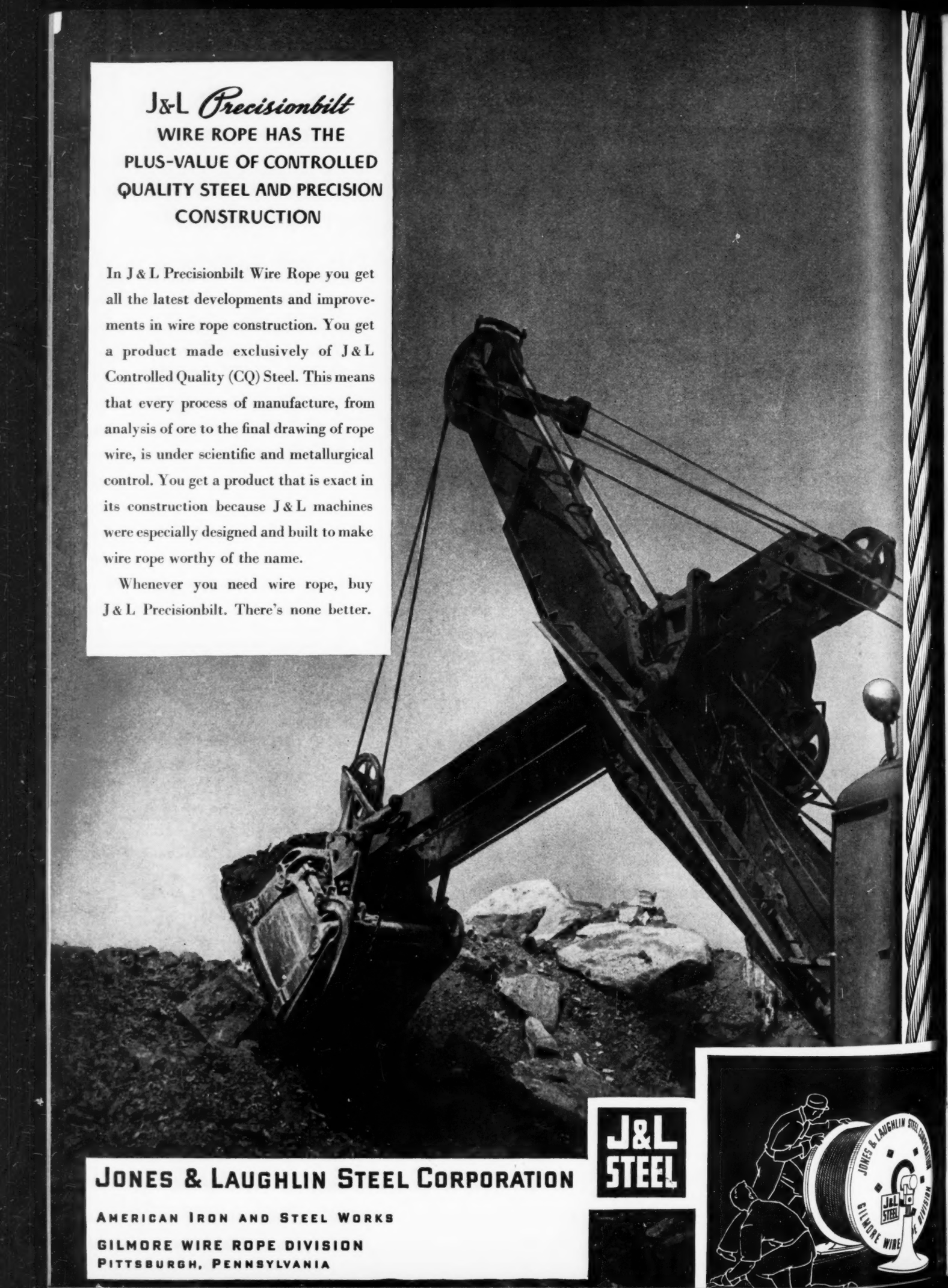

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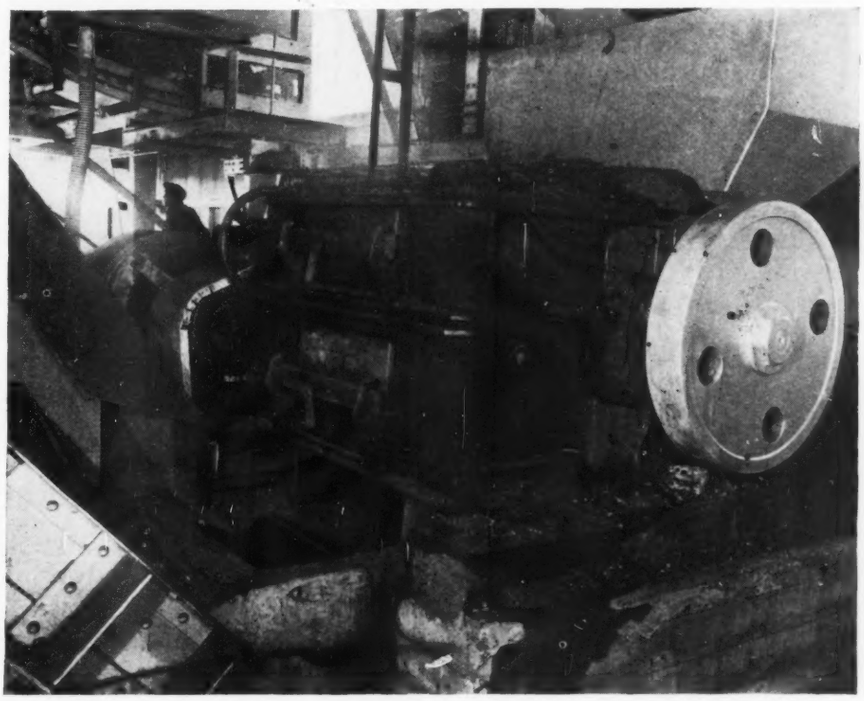

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IT FLIES UNDER GROUND

With the Greatest of Ease ...AND EFFICIENCY!

Nearest approach to perpetual motion in today's coal mining operations is the belt conveyor... carrying a steady stream of packaged B.T.U.'s, hour after hour, day after day, month after month. Here is pictured the delivery end of a type 97 Goodman Portable Sectional Conveyor... properly equipped with a 30-inch U. S. Rubber Underground Conveyor Belt... operating under low ceiling and over uneven floors. This 2410 ft. "mother" belt is but one of a fast increasing number of U. S. Conveyor Belts operating underground in mechanized mining... cutting costs, increasing output, giving SERVICE BEYOND PRICE and SPECIFICATIONS.

United States Rubber Company

1790 Broadway — New York, N. Y.

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT — USED or RESALE

UNDISPLAYED—RATE PER WORD:

Positions Wanted (full or part-time salaried employment only) 5 cents a word, minimum $1.00 an insertion, payable in advance. (*See ¶ on Box Numbers*)

Positions Vacant and all other classifications, 10 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads. Replies forwarded without extra charge.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

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The advertisement rate is $5.50 per inch for all advertising appearing on other than a contrast basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL 20TH OF MONTH FOR THE ISSUE OUT THE FOLLOWING MONTH C.A.

BUSINESS OPPORTUNITIES

Rail-River Mines

Anyone interested in purchasing or leasing rail-river mines or in taking the production thereof, address BO-516, Coal Age, 520 N. Michigan Ave., Chicago, Ill.

SELLING OPPORTUNITIES

OFFERED—WANTED

Selling Agencies—Sales Executives
Salesmen—Additional Lines

OPPORTUNITY OFFERED

SALESMAN WANTED. Traveling Salesman for West Virginia, Virginia and Kentucky, selling Storage Battery Locomotives, Trolley and Cable Reel Locomotives, Coal Conveyors, and Mine Pit Car Loaders. Experienced man only need apply. Position may eventually develop as Sales Manager. Correspondence confidential. SW-515, Coal Age, 520 N. Michigan Ave., Chicago, Ill.

FOR SALE

TESTED SOUTHERN ILLINOIS Strip Coal Acreage. Near large operating mines convenient to two railroads. For details and price write R. E. Renfro, Grayville, Ill.

WANTED

From Coal Mining Company Electric Locomotives Coal Cutters Synchronous M-G Sets 200 k.w. Mine Hoists. W-517, Coal Age, 330 W. 42nd St., New York, N. Y.

FOR SALE

Electrically Equipped Mine

Low volatile, Western Pennsylvania, now operating, 100,000 tons available.

BO-512, Coal Age
330 West 42d St., New York City

DIAMOND CORE DRILLING, for any mineral. Established 1902. More than fifty steam, gasoline and electric drills, suitable for any job. Our Specialty,—testing bituminous coal lands. Satisfactory cores guaranteed. Prices very reasonable.

O. C. HOFFMAN, Pres. L. H. HOFFMAN, Treas.
HOFFMAN BROS. DRILLING CO.
Contractors
PUNXSUTAWNEY, PA. TELEPHONE 382

WE LOOK INTO THE EARTH

By using Diamond Core Drills. We drill for Limestone Gypsum, Talc, Fire Clay, Coal and all other minerals.

PENNSYLVANIA DRILLING CO.
Drilling Contractors
Pittsburgh, Pa.

WANTED

USED MINE CARS

42" Gauge

W-518, Coal Age
330 W. 42nd St., New York City

ROTARY CONVERTERS

1—300 KW GENERAL ELECTRIC
1—300 KW ALLIS CHALMERS
for
275 Volts D.C.—Any A.C. Voltage

Both units pedestal bearing, complete with swbds., 1200 rpm, Single Phase transformers.

Now Available — Select Bargains
LOCOMOTIVES
CRUSHERS
MINING MACHINES
TRANSFORMERS
A.C.—MOTORS—D.C.

1—200 kw Ridgway 80 P.F. Synch, MG Set 275 Volts D.C., 1200 rpm, complete

JOHN D. CRAWBUCK CO.
Engineers—Appraisers
506 EMPIRE BLDG. PITTSBURGH, PA.

LOCOMOTIVES

20-Ton WESTGHE, 550 V. 909 Mts. 44"-36" Ga.
15-Ton WESTGHE, 250 V. 909-C Mts. 48"-36" Ga.
13-Ton JEFFREY, 250 V. MH-110 Mts. 44"-36" Ga.
10-Ton JEFFREY, 250 V. MH-110 Mts. 44"-36" Ga.
10-Ton GOODMAN, 250 V. 29-A Mts. 36" Ga.
8-Ton JEFFREY, 250 V. MH-100 Mts. 48"-36" Ga.
8-Ton JEFFREY, 500 V. MH-100 Mts. 48"-36" Ga.
8-Ton JEFFREY, 250 V. MH-85 Mts. 36"-24" Ga.
8-Ton WESTGHE, 250 V. 906-C Mts. 48"-36" Ga.
6-Ton JEFFREY, 250 V. MH-88 Mts. 44"-36" Ga.
6-Ton WESTGHE, 250 V. 904-C Mts. 48"-42" Ga.
4-Ton WESTGHE, 250 V. 902-C Mts. 36" Ga.

SUB-STATIONS

750 KW WEST. Syn. M.G. Set, 250 V., 900 RPM
300 KW G.E. Syn. M.G. Set, 275 V., 1200 RPM
300 KW G.E. Syn. Converter, 275 V., 1200 RPM
300 KW G.E. Syn. Converter, 575 V., 1200 RPM
200 KW G.E. Syn. M.G. Set, 275 V., 1200 RPM
200 KW G.E. Syn. Converter, 275 V., 1200 RPM
150 KW WEST. Syn. M.G. Set, 275 V., 1200 RPM
100 KW. G.E. Syn. M.G. Set, 275 V. 1200 RPM

AIR COMPRESSORS

1302' I-R, PRE-2, Dir. Con. 440 V. Syn. Mt. 100#
1050' I-R, PRE-2, Dir. Con. 2300 V. Syn. Mt. 100#
1052' I-R, XCB, Belted 2300 V. Syn. Mt. 100#
676' I-R, XRE, Dir. Con. 2300 V. Syn. Mt. 100#

Each unit listed above is owned by us and is available for immediate shipment.

WHAT HAVE YOU FOR SALE?

WALLACE E. KIRK COMPANY
Incorporated
502-D Grant Building Pittsburgh, Pa.

EMERGENCY NEED?

Freight Cars; any kind
Locomotives; all types
Relaying Rails
Freight Car Repair Parts

Perhaps we can supply your requirements, and *immediately?*

Other Machinery and Equipment Too!

IRON & STEEL PRODUCTS, Inc.
13484 S. Brainard Ave., Chicago, Ill.
"Anything containing IRON or STEEL.

MINE RAILS

Guaranteed Practically Equal to New, Super Quality Machine Reconditioned—not ordinary Relayers.

Standard Modern Section and Drilling
6,000 ton—20 lb. to 40 lb.
10,000 ton—45 lb. to 130 lb.

Priced at $200 to $500 per carload less than cost of New Rails. Less carload—in proportion.

Fully Guaranteed — shipped anywhere — subject inspection and approval at your Mine.

NEW RAILS, FROGS & SWITCHES, SPLICE BARS, TIE PLATES, BOLTS, NUTS, SPIKES, GAUGE RODS, OTHER ACCESSORIES

Shipment from stock. Phone, write, or wire for quotation.

L. B. FOSTER CO.
PITTSBURGH - CHICAGO - NEW YORK

POWER PLANT EQUIP.

500 KVA G.E. 3 ph. 60 cy. Alt. d.c. to Erie Ball 4 val. eng.
750 KW Westgh. Turbo set 250 v. D.C. mixed pres. 4 lbs. & 110 lbs.
2200 Cu. Ft. 100 lbs. Chg. Pn. steam compressor.

MG SETS—R. CONVERTERS

500 KW Burke M-G set 275 v. 2200 v. 600 rpm.
300 KW G.E. Rotary HCC 275 v. 1200 rpm.
300 KW Ridg. 275 v. 2300/4000 v. .8 P.F. 1200 with full automatic AC and DC Panels.
300 KW Westgh. 550 v. 2300/4000 .8PF. 1200 rpm.
200 KW Ridg. 275 v. 2300/3/60/900 rpm.
150 KW Westgh. 275 v. 2200/3/60/1200 rpm.
100 KW Ridg. 275 v. 2200/3/60/1200 rpm.

LOCO.—MINING MACHINES

13 Ton Jeffrey armourplate 42" ga. MH110.
10 Ton Goodman 34 BB Motors 42" ga.
6 Ton Jeffrey 42" ga. with reel or crab.
4 Ton Jeffrey 36/42" ga. with elec. reel.
112DA Goodman #6107, 250 v. 36" ga.
12AA Goodman 250 v. 6' cutter bar.
112G3 Goodman AC Univ. Low vein truck.

SLIP RING MOTORS, 2200/3/60

750 HP Cr. Wh. 250 rpm. Ped. Brgs.
700 HP G E. MT. 450 rpm.
500 HP G.E. MT. 393 rpm.
400 HP Cr. Wh. 360 rpm. Ped. Brgs.
300 HP Cr. Wh. 350 rpm. Ped. Brgs.
200 HP Cr. Wh. 440 rpm. Brac. Brgs.

MOORHEAD-REITMEYER CO., Inc.
Columbia Bldg. Pittsburgh, Pa.

MINE EQUIPMENT

Locomotives
Mining Machines
Rotary Converters & M.G. Sets
Hoist, Large or Small
Hydraulic Wheel Presses

Good Equipment at Attractive Prices
Stock list upon request

The INDUSTRIAL EQUIPMENT CORP.
P.O. Box 1647 Pittsburgh, Pa. Warehouse Carnegie, Pa.

WE OWN AND OFFER FOR SALE

The Following Items at Extremely Low Prices

SYNCHRONOUS ROTARY CONVERTERS

1—300 KW General Electric, type HCC-6, form P, 1200 RPM, 275 volt DC, with switchboards and instruments, including transformers for 2300/4000 volt.
2—200 KW General Electric—same specifications as above set.
1—200 KW General Electric, type HCC-6, form P, 1200 RPM, 275 volt DC, with switchboards and instruments, including transformers for 6600/4000 volt.
1—150 KW Westinghouse, late pedestal type, 275 volt DC, 1200 RPM, switchboards and instruments for the AC and DC end. Guaranteed 100% against electrical or mechanical defects.

MOTOR GENERATOR SETS

1—200 KW Westinghouse practically new, 1200 RPM, 250/275 volt DC, 2300/4000 volt AC, complete with switchboards and full automatic equipment for the AC and DC end. Guaranteed 100% against electrical or mechanical defects.

LOCOMOTIVES—250 VOLT DC

1—20-ton Jeffrey, MH-77, 36" to 42" gauge.
8—15-ton Jeffrey, MH-110, 36" to 44" gauge.
3—13-ton Jeffrey, MH-110, 36" to 44" gauge.
2—15-ton Goodman, 36-A, 36" to 44" gauge.
4— 8-ton Goodman, 32-0, 36" to 42" gauge.
5— 6-ton Goodman, 33-I, 36" to 42" gauge.
3—10-ton Goodman, 34-B, 36" to 42" gauge.
2—10-ton Jeffrey, MH-110, 36" to 44" gauge.
8—6-ton Jeffrey, MH-88 Gathering, 36" to 44" gauge.

MISCELLANEOUS

2—Jeffrey 29-LE Cutting and Shearing Machines, 250 volt DC, used only a short time.
10—Horizontal mechanical driven gathering reels, 250 volt for Jeffrey MH-88, gathering locomotives.
1—New switchboard complete with all necessary instruments for a 300 KW Motor Generator Set, 250/275 volt DC, 2300 volt AC.
3—Bury 6x6 Portable Air Compressors.
2—Safety Appliance Company Rock Dusting Machines.

WE ALSO HAVE LATE TYPE EQUIPMENT IN THE FOLLOWING ITEMS:

AC MINING MACHINES
DC MINING MACHINES
ARCWALL MACHINES
LOADING MACHINES OF ALL TYPES
COMPLETE POWER PLANT EQUIPMENT
SHEARING MACHINES
ELECTRIC AND STEAM HOISTS
STEEL AND WOOD TIPPLES

MOTOR GENERATOR SETS AND ROTARY CONVERTERS

ALL EQUIPMENT OFFERED AT EXCEPTIONALLY LOW PRICES

We Specialize in Buying Complete Mines That Are Going Out of Business or From Receivers in Bankruptcy, Administrators of Estates, Etc.

Our Financial Responsibility is Your Guarantee of Satisfaction!

COAL MINE EQUIPMENT SALES COMPANY

FRANK J. WOLFE

306-7 Beasley Building — L. D. Phone-34 — Terre Haute, Indiana

UNUSUAL REBUILT MACHINERY

FROM

OUR REGULAR STOCK

Rebuilt Mining Equipment

Locomotives:

4— 6 Ton MH- 88 Jeff. 250 V, 42 Ga.
2— 4 Ton MH- 96 Jeff. 250 V, 42 Ga.
1—10 Ton HM-830 Gen. Elec. 250 V, 44" ga.
5— 6 Ton HM-801 GE 250 V, 44" ga.
3— 6 Ton HM-823 Gen. El. 250 V, 44" ga.
2— 4 Ton HM-825 Gen. Elec. 250 V, 42-48 ga.
1—10 Ton 34-B Goodman 250 V, 42 ga.
1— 5 Ton 8-A Goodman 250 V, 44" ga.
2— 6 Ton 904-C Whse. 250 V, 42-48 ga.
2— 4 Ton 902-C Whse. 250 V, 42-48 ga.
1— 4 Ton "C" Morgan-Gard. 250 V, 42 ga.

Mining Machines:

2—29B, 250 V, Jeffrey
4—12-AA, 250 V, Goodman
1—35B, 250 V, Mining Machine
5—112-AA, 210 Volts, Universal Goodman mining machines

Sub Station:

2—150 KW, Gen. Elec. Rotary Converter
1—100 KW, Gen. Elec. 550 V, Rotary Converter
1—100 KW, Gen. Elec. Rotary Converter
1—100 KW, Ridgway Motor Generator Set
2— 75 KW, Gen. Elec. Motor Generator Set
1—General Electric 550 volt Rotary Converter, type HCC 6
1—300 KW, 275 volt HCC Rotary

Coal Crusher:

1—36x36 Jeffrey

Also

Armatures
Aerial Tramway
Compressors
Circuit Breakers, AC & DC
Controllers, AC & DC
Hoists, Single & Double Drum
Motors, AC & DC
Car Retarders
Resistance
Transformers
Field Frames
Mining Machine Trucks
Switch Boards
Pumps, Plunger
Pumps, Centrifugal
Lathes, Drill Press
Blowers
Chain Blocks & Trolleys
Electric Drills
Grinders
Cable Reel Motors, GE & Jeff.
Hoist, Boom, D. C.
Bit Sharpener (Sullivan)
Electric Siren

BECKLEY MACHINE & ELECTRIC CO.

Beckley, W. Va.

-TRANSFORMERS-

A Complete Stock — **Prompt Shipment**

3—250 KVA Pittsburgh Transformers, 60 cycle, 13200/26400 —440 volts **$650.00** Each

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
Write for Catalog No. 134B

THE ELECTRIC SERVICE CO., INC.

"AMERICA'S USED TRANSFORMER CLEARING HOUSE"

STATION M — Since 1912 — CINCINNATI, OHIO

COAL STRIPPING SHOVEL

No. 300 Marion Steam Shovel with 80 Ft. boom having 9 Yard bucket. Weight about 300-tons. Excellent condition.

Immediate Delivery.

Marr-Galbreath Machinery Company

58 Water St. — Pittsburgh, Pa.

RAILS—CARS

All sections of rails and good serviceable second-hand cars, all gauges, also spikes, bolts, frogs, switches and ties.

M. K. FRANK

480 Lexington Ave., New York City — 450 Fourth Ave., Pittsburgh, Pa.

OIL SWITCHES
AIR CIRCUIT BREAKERS
SAFETY SWITCHES

Bought—Sold

CIRCUIT BREAKER COMPANY

347 N. Clinton Ave. Rochester, N. Y.

8 NEW General Electric 3 HP, 1150 RPM, 230 volt, compound D.C. Motors, at 25% of cost.

USED cutting machines A.C. and D.C.

CRAWFORD MACHINERY CO.

Fulton Building — Pittsburgh, Pa.

Electric Locomotives

1—13 ton Jeffrey, with MH-110 motors.
1—10 ton Jeffrey, with MH-110 motors.
2—8 ton General Electric.
3—6 ton Jeffrey.

Mining Machines

3—212-G-3 Goodman Lowvein AC.
1—312-G-3-A Goodman Lowvein Universal type, AC.
1—36-B Jeffrey Longwall Lowvein DC.
3—35-B Jeffrey, 250 volts DC.
2—35-B Jeffrey, 500 volts DC.
2—35-BB Jeffrey, AC, 220-440 volts.

Substation

1—500 KW Ridgway MG Set, 275 volts DC.
2—300 KW General Electric MG Sets, 275 volts DC.
2—150 KW General Electric MG Sets, same as above.
1—100 KW General Electric MG Sets, same as above.

We have all other types of Coal Mining Equipment.

Tippins Machinery Company

Koppers Building — Pittsburgh, Pa.

MINE HOISTS

1—**Diamond** Band Friction 18" diameter with 50 H.P. electrical equipment.
1—**Flory** 30" diameter complete with 60 H.P. electrical equipment.
1—**Lidgerwood** Friction Drum hoists, 36" diameter, 3000 feet ¾" rope, 75 H.P. electrical equipment.
1—**Vulcan** Double Drum Electric Shaft Hoist with 75 H.P. electrical equipment.
1—**Lidgerwood** Electric Shaft Hoist 50" drum, 150 H.P. electrical equipment.
1—**Vulcan** Shaft Hoist Single drum 72" drum, 150 H.P., 2200 volt electrical equipment.
1—**Vulcan** Haulage Hoist with 350 H.P. electrical equipment.
1—**Vulcan** Cylindro-Conical shaft hoist, 400 H.P., 2200 volt complete with safety devices.

And other hoists to suit all mining conditions

Jones Mining Equipment Company

541 Wood Street — Pittsburgh, Pa.

RE-NU-BILT MOTORS GENERATORS TRANSFORMERS LARGE & HEAVY ELECTRIC POWER EQUIPMENT

Thoroughly Tested Before Shipment *and* Guaranteed

RE-NU-BILT BELYEA MOTORS

MORE THAN 50% SAVING

BELYEA CO. INC.

44 HOWELL STREET
JERSEY CITY, NEW JERSEY

AIR COMPRESSORS:
(7) Steam 66 ft., 300 ft., 600, 1000 & 1940 ft.
(12) Belted, 360, 676, 870, 1300 ft.
(6) Electric, 1300, 1500, 2600, 5000 ft.
(14) Gasoline, 110, 160, 220, 310 & 370 ft.

COAL CRUSHERS:
Jeffrey Single Roll 18x18, 24x24 & 30x30
Link Belt 26x24 Double Roll Crusher

HYDRAULIC CARWHEEL PRESSES:
100 Ton, 150 Ton, 200 Ton, 300 & 400 Ton Caldwell - Niles - Wood - Watson Stillman

RUBBER CONVEYOR BELTS:
1000' 60", 600' 30", 300' 20", 1600' 42", 500' 40", 1450' 36", 1200' 24", 900' 18", 600' 16", 350' 14".

CONVEYOR PARTS:
Idlers, Head & Tail Pulleys, Steel Frames, Tripper, etc., 14 In., 60 In. Large Stock in Jersey Warehouse.

HOISTING ENGINES:
800 H.P. 6'x38" Single Drum Elec. Incline
600 H.P. 2 Drum 10'x8'6" Elec. Shaft
400 H.P. Single Drum 6'x4'6" Elec. Incline
400 H.P. Double Conical Drum 6' to 8' Elec. Shaft
350 H.P. Single 6'x8' Drum Elec. Incline
350 H.P. Double 4'x3' Drum Elec. Shaft
150 H.P. Single 6'x3' Drum Elec. Incline
110 H.P. Single 4'x3' Drum Shaft or Incline
Gas 15, 30, 60, 80 & 100 HP
Steam 6x7, 7x10, 8¼x10 & 10x12

SYNC. MOTOR GENERATORS:
100 KW Westgh. 900 RPM 3/60/2200-250-275
100 KW Ridgeway 1200 RPM 3/60/2200-250-275
150 KW G.E. 1200 RPM 3/60/2200-250-275
200 KW Ridgeway 900 RPM 3/60/2200-250-275

STORAGE BATTERY LOCOMOTIVES:
2½ ton Whitcomb 24 ga. New Batteries
2—4 Ton G.E. 30 in. ga.
3—5 ton Mancha 30 in. ga.
5 ton G.E. 36 in. ga.
3—7 ton Goodman 36 ga. Battery & Trolley
6 ton Baldwin Westgh. 42 ga.

TROLLEY LOCOMOTIVES:
2½ ton Westinghouse 24 ga.
5 ton Goodman 36 ga.
3—6 ton Goodman 36 ga.
4—6 ton Goodman 42 ga.
5—6 ton Westinghouse 42 ga.
10 ton Goodman 42 ga.
13 ton Goodman 42 ga.

VIBRATING SCREENS:
9 Tyler Hummer 3x6, 4x5 & 4x10
2 Robins Gyrex 4x8½
4x12 Niagara, 3x8L. B., 5x6 Simplex

SHOVELS, CRANES & DRAGLINES:
1 yd. K30 Link Belt 50' Boom Crane
1¼ yd. Marion Diesel Shovel
1¼ yd. Marion 450 Elec. Shovel
1½ yd. Lima Diesel Shovel & Dragline
2 yd. Link Belt Elec. Shovel & Dragline
25 ton Browning 50' Boom Loco. Crane
7 Conway 20A, 30A, 50A & 60 Muckers

MISCELLANEOUS:
5'x60' Traylor Rotary Dryer
100 HP G.E. 3/60/440 v.-900 RPM Elec. Motor
6 Goodman 12CA & 12 DA 6 ft. Cutters
9 x 8 Sullivan Mine Compressor
Clamshell Buckets ¾, 1, 1½ & 2 yd. cap.

WANTED TO BUY:
Complete Mines—M.G. Sets, Locomotives, Compressors, Conveyors, Cranes, Crushers & Rotary Converters

Tidewater Equipt. & Machy. Corp.
875 Sixth Ave. New York, N. Y.

TRANSFORMERS

OUTDOOR TYPE • OIL COOLED • 60 CYCLE

3—G.E. 50 KVA HK 4200/230/460
3—Pitts 100 KVA 2200/220/440
2—WE&M 37½ KVA S 2300/230/460
2—Pitts 37½ KVA 2300/230/460
3—Pitts 100 KVA 2300/230/460
5—GE 100 KVA 4200/230/460
3—GE 100 KVA HKS 2300/230/460
1—WE&M 100 KVA SK 2300/230/460
1—WE&M 75 KVA SK 2300/230/460
3—GE 75 KVA HKR 11000/2300—Unused
2—GE 50 KVA HGQT 6600/13200/115/230/460
3—GE 15 KVA HN 2300/230/460
3—GE 75 KVA 25 cycle 2300/230/460
3—Pitts 25 KVA 2300/230/460
6—GE 15 KVA 2300/230/460
6—GE 25 KVA 2300/230/460
3—GE 10 KVA 2300/230/460
6—WE&M 5 KVA 2300/230/460
3—GE 1½ KVA 2300/230/460
1—GE 10 KVA 2200/244/488
3—GE 1500 KVA 23000/2300/4000y
6—GE 400 KVA 22000/11000/2300/4000y
3—Pitts 100 KVA 22000/11000/230/460
3—WE&M 37.5 KVA 2300/115/230
11—Pitts 15 KVA 2300/115/230
1—WE&M 50 KVA 4000/115/230
2—GE 100 KVA 4200/115/230
1—GE 50 KVA 2300/115/230
1—Pitts 7.5 KVA 4600/115/230
1—WE&M 15 KVA 4000/115/230 3 ph
2—WE&M 15 KVA 4000/115/230
1—WE&M 5 KVA 4000/115/230 3 ph
5—GE 25 KVA 2300/115/230
1—WE&M 30 KVA SK 4600/115/230
1—WE&M 30 KVA 2200/244/488
1—WE&M 25 KVA S 2300/115/230
1—WE&M 5 KVA 4800/2400/115/230
4—WE&M 5 KVA 2300/215/230
3—GE 3 KVA 2300/115/230
3—GE 1½ KVA 2300/115/230
2—WE&M 10 KVA 2300/115/230
1—Maloney 3 KVA 4160/120/240
3—WE&M 15 KVA SK 4600/115/230
1—Pitts 10 KVA 4600/115/230
1—GE 15 KVA 4600/115/230

MOTORS

Special Items At Bargain Prices

SLIP RING MOTORS
220/440 Volts, 60 Cy. 3 Ph.

250 H.P. WEM	CW		503 RPM
400 H.P. WEM	CW		1200 RPM
250 H.P. GE	I-M		585 RPM
100 H.P. GE	I-M		600 RPM
100 H.P. WEM	CW		900 RPM
100 H.P. GE	MTC	5552	690 RPM (new)
40 H.P. WEM	CI	654D	690 RPM (new)
200 H.P. WEM	CI		585 RPM
200 H.P. WEM	CW		500 RPM
300 H.P. GE	I-M		585 RPM 3 bearing

2200 Volts, 60 Cy. 3 Ph.

300 H.P. GE	I-M	585 RPM 3 bearing
300 H.P. GE	LE 15	1200 RPM
400 H.P. WEM	CW	1200 RPM
	with full magnetic control	

SQUIRREL CAGE
220/440 Volts, 60 Cy. 3 Ph.

200 H.P. GE	I-M	1800 RPM
300 H.P. Allis		900 RPM
100 H.P. GE	KT 543	1800 RPM
100 H.P. GE	I-K	450 RPM
100 H.P. WEM	CS	870 RPM
75 H.P. GE	I-K	720 RPM
300 H.P. GE	IE 15B	1200 RPM
40 H.P. GE	KF 504	900 RPM BBear (new)
40 H.P. GE	KF 445	1200 RPM BBear (new)
50 H.P. GE	KF 504	1200 RPM BBear (new)
60 H.P. GE	KF 505	1200 RPM BBear (new)

2200 Volts, 60 Cy. 3 Ph.

200 H.P. GE	IE 15B	1200 RPM
300 H.P.	Allis	1800 RPM
40 H.P. Elec. Machy.		1800 RPM
50 H.P. WEM	CS	900 RPM

In addition to the above, which are being offered at bargain prices, we carry in Scranton stock hundreds of others, A.C. and D.C. motors, motor generator sets, mine locomotives, hoists and other items.

We are prepared to rent—buy—sell or exchange equipment of all sizes and types. Wire—write or 'phone your requirements or send us your lists of equipment for disposal.

PENN ELECTRICAL ENGINEERING COMPANY
Phones 8175—6—7—8
537 ASH STREET SCRANTON, PA.

REBUILT ROTARY CONVERTERS

(In our Stock)

2—100 KW., type TCC, 1200 rpm., 250/275 volts d-c., cpd. wound, G.E. 60 cycle
1—150 KW., type HCC, 1200 rpm., 250/275 volts d-c., cpd. wound, G.E. 60 cycle
1—200 KW., type HCC, 1200 rpm., 250/275 volts d-c., cpd. wound, G.E. 60 cycle
1—200 KW armature for type HCC, 1200 rpm., cpd. wound, 250/275 volt d-c. G.E. 60 cycle rotary
1—200 KW., 1200 rpm., 250/275 volts d-c., cpd. wound, new Ridgway 60 cycle
1—200 KW., type HCC, 1200 rpm., 550/600 volts d-c., cpd. wound, G.E. 60 cycle
1—300 KW., 1200 rpm., 250/275 volts d-c., cpd. wound, Westinghouse 60 cycle.
1—300 KW., type HCC, 1200 rpm., 550/600 volts d-c., cpd. wound, G.E. 60 cycle
2—500 KW., otherwise ditto.

Transformers and manually-operated switchboards are carried in stock for above machines. Full-automatic or semi-automatic switchboards can be supplied to meet any operating condition.

ALSO IN STOCK

A.C. & D.C. Motors
Motor-Generator Sets
Electric Control
Transformers
House Meters (recalibrated)
Air & Oil Circuit Breakers
Mining Machinery & Hoists
Machine Tools, Etc.

R. H. Benney Equipment Company
5024 Montgomery Rd., Norwood, Ohio

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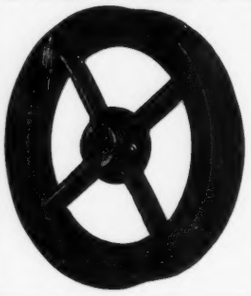

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